GLOBAL ARMS TRADE

COMMERCE IN ADVANCED MILITARY TECHNOLOGY AND WEAPONS

CONGRESS OF THE UNITED STATES
OFFICE OF TECHNOLOGY ASSESSMENT

J45263

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About the cover: Each weapon represents $1 billion worth of arms transferred in 1988. Exports in blue, imports in gray.

GLOBAL ARMS TRADE

CONGRESS OF THE UNITED STATES
OFFICE OF TECHNOLOGY ASSESSMENT

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Foreword

The recent war in the Persian Gulf has once again focused attention on the proliferation of advanced weapons and the international arms industry. Although Iraq had little or no defense industrial capability, it was able to obtain a vast arsenal of modern weapons from the Soviet Union, Western Europe, China, Eastern Europe, and a variety of arms producers in the developing world.

Today, the international arms market is a buyers' market in which modern tanks, fighter aircraft, submarines, missiles, and other weapons are available to any nation that can afford them. Increasingly, sales of major weapons also include the transfer of the underlying technologies necessary for local production, resulting in widespread proliferation of modern weapons and the means to produce—and even develop—them.

The end of the Cold War has brought profoundly decreased demand for weapons by the United States, the Soviet Union, and most European governments. In the United States, and elsewhere, some defense companies are seeking to increase their international sales as part of a strategy to adjust to the new realities of lower procurement budgets and less domestic demand for their products. But because of worldwide overcapacity in defense production, competition is fierce and sales arrangements are complex, increasingly bypassing government-to-government agreements.

Congress faces two very important and interconnected issues: 1) controlling the proliferation of modern weapons and defense technology and 2) the health of the U.S. defense industries. This report, the final product of OTA's assessment on international collaboration in defense technology, explores the form and dynamics of the international defense industry, the intricacies of technology transfer and equipment sales, and the implications for U.S. policy. An interim report, *Arming Our Allies: Cooperation and Competition in Defense Technology*, was published in May 1990.

This assessment was requested by the Senate Committee on Armed Services and the House Committee on Government Operations. OTA particularly wishes to acknowledge the assistance of the Foreign Affairs and National Defense division of the Congressional Research Service in preparing part of this report.

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Chapter 1

Global Defense Business and Arms Proliferation

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Chapter 1

Global Defense Business and Arms Proliferation

OVERVIEW AND PRINCIPAL FINDINGS

The war in the Persian Gulf graphically demonstrated the consequences of extensive international commerce in powerful advanced conventional weapons. At the same time, the end of the Cold War and the accompanying decline in defense spending have weakened the political foundation for continuing arms transfers and enhanced the economic motivations for international arms sales. Worldwide, the defense industries face deep recession (and probable permanent adjustment to much lower levels of production) brought on by a general erosion of demand and continued strong overcapacity of production.

Governments take widely differing approaches to the arms trade. Some help their defense companies seek export markets to compensate for insufficient domestic procurement budgets. Some nations view arms sales as an important source of export revenue, a way to spread development costs for new weapons, and a source of domestic employment. Others seek to enhance their stature as regional or international powers by building up a capable defense industry. One country, Japan, has prohibited the export of arms as a matter of public policy.

Traditionally, the U.S. Government has viewed arms sales and transfers primarily as instruments of foreign policy—to exert regional influence, to strengthen alliances, and to oppose the expansion of Communist power. In the past 2 years, some government officials have become concerned over the likely loss of important elements of the domestic defense industry as companies adjust to dramatic declines in domestic procurement; they have become more sympathetic to the desire of U.S. defense companies to increase export sales.[1] International sales, however, proliferate advanced weapons and often involve collaborative production arrangements with far-reaching consequences.

This situation poses a major national policy dilemma—how to balance the use of arms exports as instruments of foreign policy, pressure by companies for greater access to foreign markets, the need to stem a dangerous worldwide arms buildup, and the increasing proliferation of both defense equipment and defense industry. This report, the final product of OTA's assessment on international collaboration in defense technology, explores the form and dynamics of the international defense industry, the intricacies of technology transfer and equipment sales, and the implications for U.S. policy.

Several factors suggest a review of U.S. policy on arms exports and collaboration in military technology:[2]

- The winding down of the Cold War is exerting an immediate and powerful downward pressure on defense expenditures in the West as governments implement budget cuts and force reductions associated with decreased East-West tensions;
- The emergence of new centers of advanced defense industry and technology is accelerating the proliferation of modern weapons (and increasing overcapacity in worldwide weapons production); and
- Western nations have helped arm Iraq, the rest of the Middle East, and other regions with little concern or oversight about the near- or far-term consequences.

The end of the Cold War has radically transformed the structure of international relations and the environment for international defense business. As the Persian Gulf War and nationalist struggles

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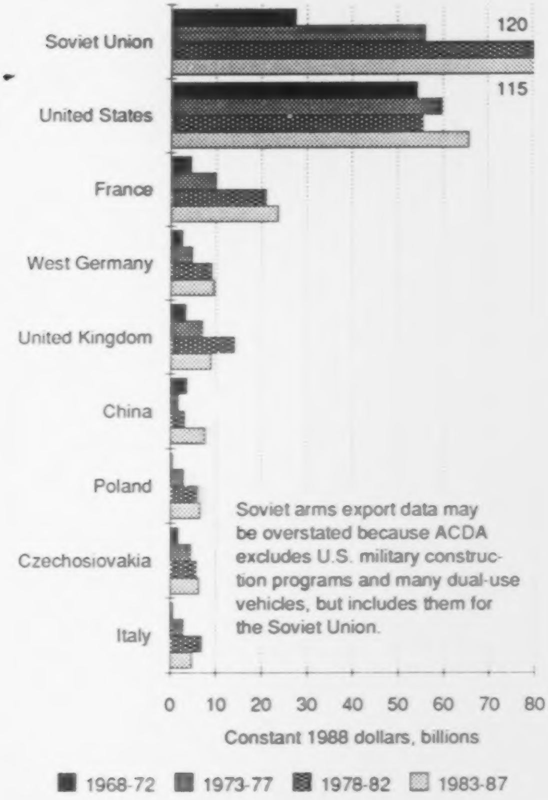
[1] The Department of State and the Defense Security Assistance Agency contend that the United States should use foreign sales to support continued domestic production of U.S. weapons systems: "Unless we adjust to the challenge of an increasingly diverse international defense supply environment, the United States will be unable to address satisfactorily the legitimate defense needs of our friends and allies, and thereby our own, at an acceptable cost in the coming years. Indeed, the long-term survival of a number of important domestic arms programs are tied to foreign sales: M1A1 Abrams battle tank, Blackhawk helicopter, HAWK surface-to-air missile, Boeing 707 aircraft, to name a few." U.S. Department of State and U.S. Defense Security Assistance Agency, *Congressional Presentation for Security Assistance Programs*, fiscal year 1992, p. 6.

[2] International collaboration can take many forms, including but not limited to transfer of technical assistance, codevelopment, co- and licensed production, and licensed assembly. It may also involve a variety of business relationships such as revenue sharing, subcontracting, consortium, joint venture, and corporate alliance, among others.

Figure 1-1—Major Arms Exporters, 1968-87



Soviet arms export data may be overstated because ACDA excludes U.S. military construction programs and many dual-use vehicles, but includes them for the Soviet Union.

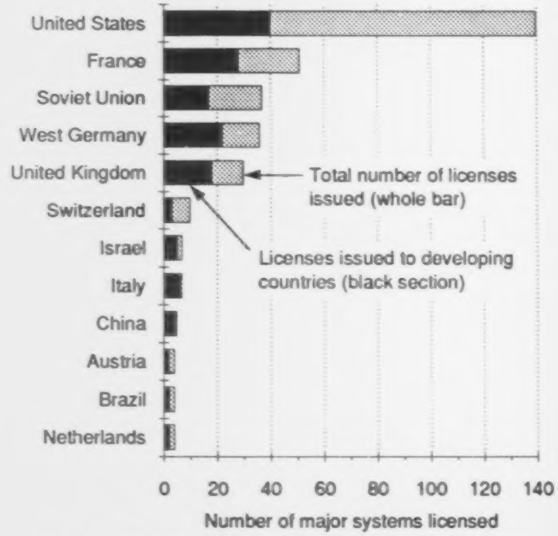
SOURCE: Office of Technology Assessment and David J. Louscher, from data in U. S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers*, various years (Washington, DC: U.S. Government Printing Office).

throughout the former sphere of Soviet influence attest, it is still too early to fill in the outlines of the emerging world order. Nevertheless, the threat of Soviet expansionism is greatly reduced, the possibility of a Warsaw Pact invasion of Western Europe has been eliminated, and the Soviet Union appears to be following a policy of restraint in arms exports. Accordingly, the defense equipment requirements of the United States and its European Allies are diminishing significantly. Moreover, a principal reason why the United States transferred weapons and defense technology to allied and friendly nations—to counter Communist influence—has been reduced.

The winding down of East-West antagonisms, however, has left profound uncertainty as to the nature and extent of future military threats to the United States, its allies, and its foreign political and economic interests. The threat may come from a variety of heavily armed nations that, like Iraq, oppose U.S. interests and forces in places and for reasons that cannot be easily anticipated. It may conceivably come from reconstituted elements of the Soviet empire. In a multi-polar world the threat of *sporadic militarism* will be reinforced and magnified by the availability of potent weapons and the knowledge of how to make and use them.

Another major factor affecting policy is the proliferation of the defense industries.[3] The arms production and export capabilities of a number of countries have expanded—in the United States, Europe, the Middle East, the Indian subcontinent, South America, and the Western Pacific (see figure 1-1). Increasingly, defense trade combines sales of finished defense systems with transfer of the underlying technologies and industrial infrastructure neces-

Figure 1-2—Worldwide Licensed Production of Major Conventional Weapon Systems, by Country Issuing License, 1960-88



10 other countries issuing fewer than 4 licenses not shown.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament*.

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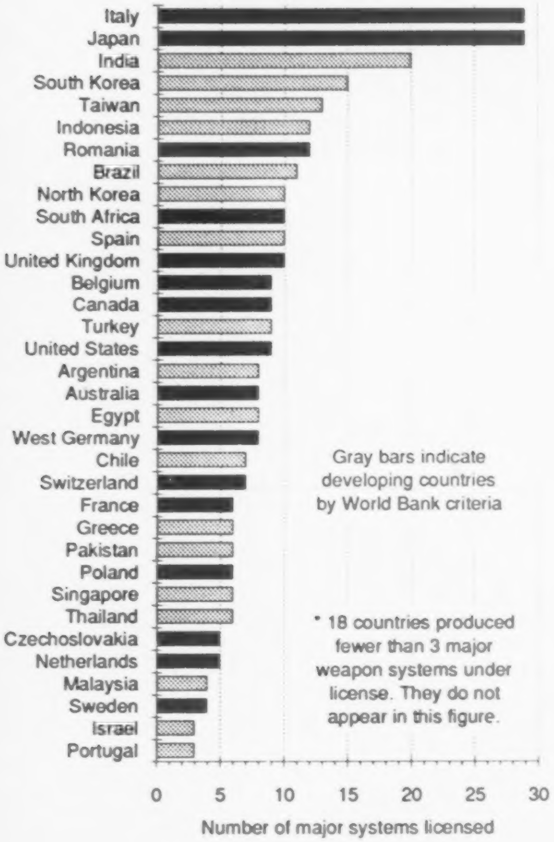
[3] Chs. 3 through 11 document this process.

Figure 1-3—Worldwide Licensed Production of Major Conventional Weapon Systems, by Country Receiving License, 1960-89



Gray bars indicate developing countries by World Bank criteria

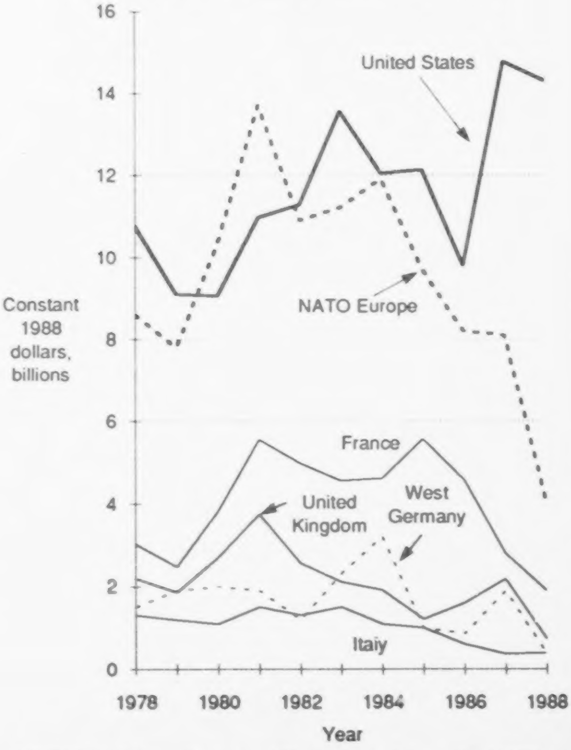
* 18 countries produced fewer than 3 major weapon systems under license. They do not appear in this figure.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament*.

sary for indigenous production (see figures 1-2 and 1-3). (These two subjects—arms sales and technology transfer—are examined in tandem throughout this assessment.) **If Congress intends to exert authority in the arms transfer field, it will have to develop clear policies regarding the transfer of U.S.-origin defense technology to foreign nations.**

Defense companies in Europe produce equipment for export markets that is often as good as and sometimes better than that exported by the United States.[4] European governments often conduct extensive diplomacy in support of arms sales. In the past, this has provided strong competition for U.S. arms exporters, especially in the Middle East, but also in the Western Pacific. Since 1986, however, U.S. arms exports have increased to a 10-year high, while NATO Europe arms exports have fallen (see figure 1-4). In 1988, the last year for which complete data are available, the United States exported $14.3 billion in arms, compared to $4.1 billion for all of NATO Europe. If this trend continues, it may place the United States in a position to exert profound influence on the course of weapons proliferation. On one hand, the United States may choose to press its present advantage, attempting to increase arms exports to the limits of existing markets. On the other hand, as the principal arms exporter in the West, the United States might decide to exercise

Figure 1-4—Arms Exports by Major NATO Weapons Producers, 1978-88



SOURCE: U. S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990), pp. 88, 111.

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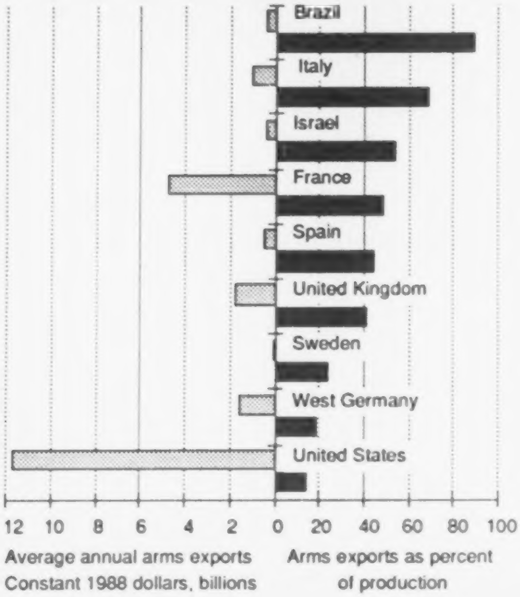
[4] The United States still maintains a lead in next-generation defense technology and systems such as the B-2 stealth bomber and the Advanced Tactical Fighter, but it does not export these systems or share the enabling technologies.

Figure 1-5—Average Annual Arms Exports, 1982-86, and Arms Exports as a Percent of Total Arms Production, 1984



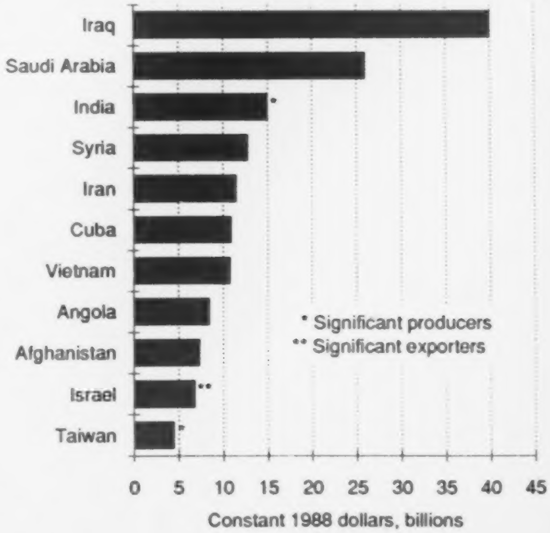
SOURCES: U. S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990), and Stockholm International Peace Research Institute, SIPRI Yearbooks 1986, *World Armaments and Disarmament* (Oxford: Oxford University Press, 1986), p. 336.

its leadership and propose to its Allies ways and means of reducing commerce in modern conventional weapons.

For reasons of national security, nations are willing to underwrite the costs of indigenous development and production of weapons, even in the face of worldwide overcapacity in the defense industries. Many, including the United States, feel much more comfortable if the source is at home. But most nations cannot buy enough domestically produced defense materiel to keep unit costs tolerably low. With the exception of the United States and Japan, procurement officials and company executives believe they must produce weapons for export markets in order to fund the next generation of weapons systems (see figure 1-5). This has created a large flow of advanced weapons to developing[5] countries like Iraq, Saudi Arabia, India, Syria, Iran, and others (see figure 1-6). Only Japan has been willing and able to subsidize enormous costs for limited production runs of sophisticated defense equipment. Operating under a U.S.-imposed constitution and a highly protective U.S. security umbrella, **Japan is the only advanced industrial nation to renounce unilaterally both the export of weapons and the projection of military power in international affairs.**

The proliferation of the ability to produce modern arms (emanating principally from the United States and Europe) has led directly and indirectly to the arming of our adversaries as well as our friends. As OTA previously reported, U.S. companies played a major role in the transfer of sophisticated defense technology to Europe, Japan, and elsewhere.[6] This was accomplished largely through international industrial collaboration, including joint ventures, licensed production, codevelopment, and direct

Figure 1-6—Major Arms Importers, 1983-88



SOURCE: U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

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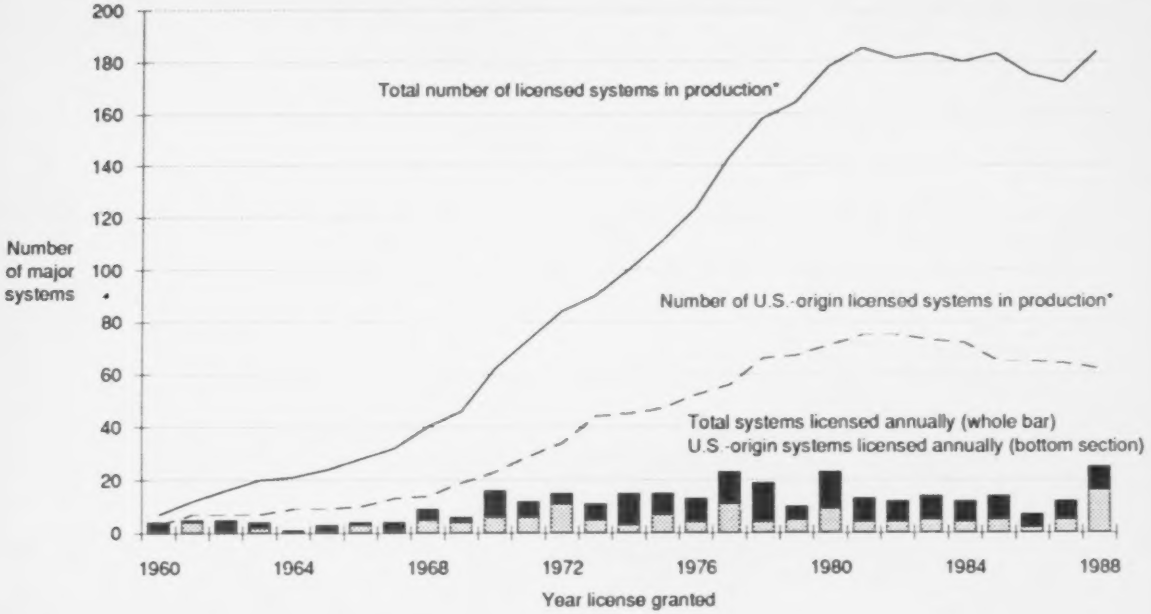
[5] In this report, the use of the term "developing" generally follows that of the World Bank—low and middle income countries, including all the nations of Africa, Latin America, and Asia, excluding Japan.

[6] For an analysis of the U.S. contribution to the development of the European and East Asian defense industries, see U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology*, OTA-ISC-449 (Washington, DC: U.S. Government Printing Office, May 1990), passim.

Figure 1-7—Estimated Worldwide Licensed Production of Major Conventional Weapon Systems, 1960-88



*Estimates based on the assumption that an average system is produced under license for 12 years.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

offsets (see figures 1-7 and 1-8).[7] Figure 1-7 shows the growth of worldwide licensed production of major weapons systems, including those licensed to other countries by the United States.[8] However, figure 1-7 substantially understates the magnitude of technology transfer because it does not count the codevelopment or licensed production of separate parts or components, which may constitute the majority of all international collaboration. Among many possible examples, the United States has recently transferred highly advanced production technology for the Stinger missile to Germany, Belgium, Greece, Italy, the Netherlands, and Turkey; for the Patriot to Japan and Italy; and for the AIM-9L Sidewinder air-to-air missile to Japan, Germany, Norway, Italy, and Taiwan.

U.S. and European defense firms have not only sold hardware but have also helped to build up the defense industries of newly industrialized nations.[9] This is often accomplished through complex foreign sales agreements in which the buyer purchases, for example, a few copies of an advanced fighter or tank, assembles a second batch under license, and manufactures the rest indigenously (also under license) to the extent that its industrial base can absorb and produce the technologies in question. U.S. firms may compete among themselves or with their

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[7] In a direct offset arrangement, the seller agrees to let the buyer manufacture parts and components of a weapons system as a condition of the sale. The seller often provides training and technical assistance and transfers technology sufficient for the buyer to undertake indigenous production of the parts or components in question. According to one definition, offsets include "a range of industrial and commercial compensation practices required as a condition of purchase of military exports." See *Offsets in Military Exports* (Washington, DC: Executive Office of the President, Office of Management and Budget, December 1988), p. 3.

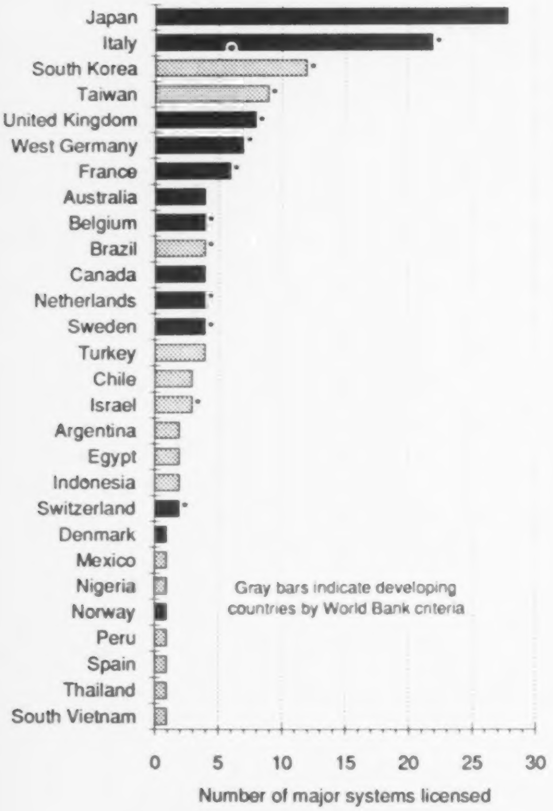
[8] Figure 1-7 shows a leveling off and slight decline in the number of major weapons systems produced under license, both worldwide and for U.S.-origin equipment. This is due in part to the 12-year production cycle (assumed in the figure) and partly because the number of new systems licensed is relatively constant throughout the 1970s and 1980s. However, 1988 (the last year for which data are available) saw the largest number of new systems licensed and the greatest increase in the number of new license agreements for U.S.-origin equipment.

[9] Chs. 5 (Israel) and 7 through 11 (South Korea, Brazil, India, Taiwan, Australia, Singapore, Indonesia) analyze the defense industries of these nations.

European counterparts to make such a sale. **A major sale can become a contest between two or more U.S. companies to see which is willing to sell the most defense technology at the lowest price.**

The proposed transfer of advanced U.S. fighter technology to South Korea, the Korean Fighter Plane, is a case in point. In 1989, South Korea agreed to buy 120 twin engine F/A-18 fighter aircraft from McDonnell Douglas for $5 billion, with 12 planes to be purchased off-the-shelf, 36 assembled from U.S.-built kits, and 72 produced under license in Korea. But by 1991, the price had risen to $6.2 billion, and the Koreans were demanding sophisticated radar, software, and composite materials technologies that the company was reluctant to release. After nearly 2 years, South Korea broke off negotiations and decided to buy the General Dynamics (GD) F-16 fighter instead. GD's ability to offer the F-16 at a lower price and to add additional technology, an advanced radar, and air-to-air missiles were decisive factors.[10]

Figure 1-8—Licensed Production of U.S. Major Conventional Weapon Systems, by Country Receiving License, 1960-88



* Countries that also issue licenses

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament*.

Photo credit: U.S. Army

The Stinger missile, which crippled the effectiveness of Soviet air power in the Afghan war, is produced under license by six European nations.

The United States and Europe routinely transfer a great deal of advanced defense technology to less developed nations. In 1988, for example, India, Egypt, Indonesia, South Korea, Taiwan, and Brazil were producing 43 different major weapons under international licensing agreements (see figures 1-9, 1-2, and 1-3).[11] As a consequence, several of these nations have attained significant defense industrial

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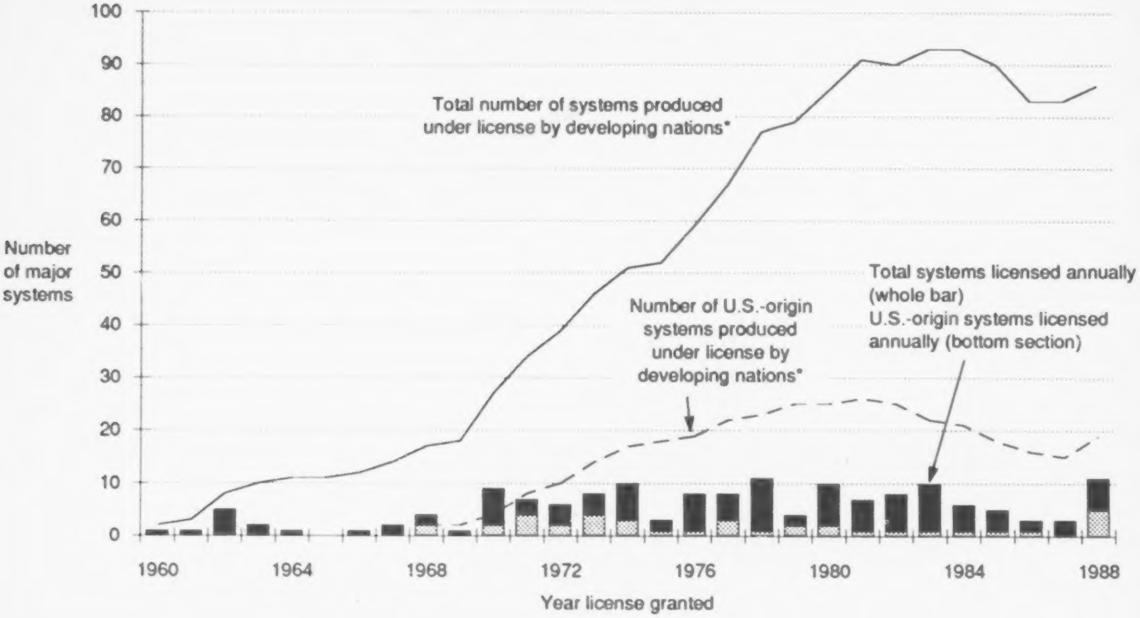
[10] *The Washington Post*, Mar. 29, 1991, p. F1; *Wall Street Journal*, Mar. 29, 1991, p. A3; *Defense News*, Apr. 1, 1991, p. 4.

[11] Major systems transferred have included the U.S. M1 Abrams tank (to Egypt), the U.S. F-16 fighter and Multiple Launch Rocket System (to Turkey), the German Type 209 submarine (to Brazil and South Korea), the Franco-German Alpha Jet (to Egypt), the Soviet MiG-27 fighter (to India), the Anglo-French Jaguar fighter (to India), the U.K. Swingfire antitank missile (to Egypt), the French Super Puma helicopter (to Indonesia), the Franco-German Milan antitank missile (to India), the German BK 117 helicopter (to Indonesia), among others.

Figure 1-9—Estimated Licensed Production of Major Conventional Weapon Systems by Developing Nations, 1960-88



*Estimates based on the assumption that an average system is produced under license for 12 years.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

capacity and have entered the arms export business. Between 1978 and 1988, the arms exported by Israel, Brazil, Spain, and South Korea amounted to $16 billion (see figure 1-10). The multiplicity of sources (both advanced and developed countries) has produced a buyers' market in which a range of modern defense equipment is generally available to any nation that can pay for it (see table 1-1).

A final factor influencing policy is that many U.S. defense companies are in financial trouble. Decreased procurement budgets and the rapidly escalating cost of weapons systems have combined to threaten the long-term economic viability of many defense companies as presently constituted. In the past 3 years, a handful of U.S. firms have collectively written off over $3.5 billion in R&D investments.[12] The impact of decreased defense business—large lay-offs and production cut-backs—has and will continue to be felt in congressional districts across the Nation.[13]

Some defense executives would like to expand international sales and collaborative ventures to increase their customer base and revenues in a declining market.[14] But they have been hindered by government ambivalence, by rapidly increasing foreign competition, and by limited demand in many markets. International business has been important to a number of major U.S. defense producers for many years; it will be increasingly critical to some companies as U.S. military procurement budgets continue to fall in the 1990s. Some important weapons plants may have to shut down, and defense

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[12] *Defense News,* Feb. 18, 1991, pp. 4, 44.

[13] Economic adjustment in the U.S. defense industries and future defense base requirements are the principal subjects of two ongoing OTA assessments: 1) "Technology Opportunities for Economic Conversion" and 2) "Managing the Nation's Defense Industrial Strength in a Changing Security Environment."

[14] Not all companies have adopted this strategy, and for those that have, it is usually only one element of an overall corporate plan to adjust to changed business conditions.

Table 1-1—Selected Weapons Exported by the United States, Soviet Union, and NATO Europe

Weapons systems	United States	Soviet Union	NATO Europe
Main battle tanks	M1 Abrams	T-80, T-72	Leopard 2 (Germany)
	M1A1		Challenger (U.K.)
	M60	T-64	Leopard 1 (Germany)
			Chieftain (U.K.)
			AMX-30B2 (France)
			Vickers Mk 3 (U.K.)
			OTO Melara OF-40 (Italy)
Fighter/attack aircraft	F-16 Falcon	MiG-29 Fulcrum	Mirage F-1 (France)
	F-15 Eagle	Su-27 Flanker	Mirage 2000 (France)
	F/A-18 Hornet	Su-24 Fencer	Tornado (U.K., Germany, Italy)
Missiles			
Air-to-air	AIM-9M Sidewinder	AA-8 Aphid	R550 Magic (France)
		AA-2 Atoll	
	AIM-7F Sparrow	AA-7 Apex	R530 (France)
			Aspide (Italy)
			Sky Flash (U.K.)
Antiship	RGM-84A Harpoon	SS-N-2 Styx	Exocet (France)
			Sea Eagle (U.K.)
			Sea Skua (U.K.)
			Penguin (Norway)
Antitank	BGM-71D TOW-2	AT-4 Spigot	Milan (France, Germany)
		AT-5 Spandrel	Eryx (France)
			HOT (France, Germany)
			Cobra (Germany)
			Swingfire (U.K.)

SOURCE: Office of Technology Assessment, 1991.

executives argue that international sales could keep them open. These factors generate strong pressures for international collaboration in defense technology and for export of top-of-the-line military equipment.

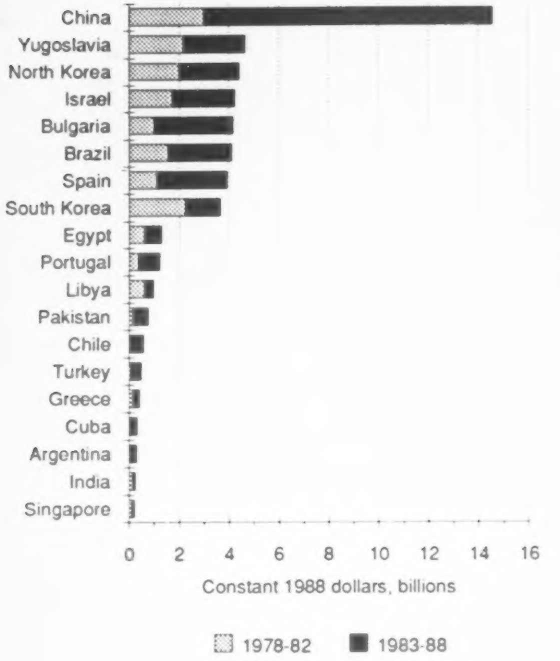
Many U.S. defense executives argue that they do not bargain away their best technology. This allows them to maintain an edge over the competition for the next sale, and assures that the United States will also enjoy a military advantage in the event U.S. troops have to face U.S.-made weapons, or those derived from U.S. designs, in combat. But the problem of proliferation is more complex. Advanced weapons systems—both old and new—emanate from many different sources and tend to fuel regional instabilities. Although they have not been in production for many years, F-4 Phantom aircraft, M-60 tanks, AH-1 Cobra helicopters, SS-1 Scud ballistic missiles, and MiG-23 Flogger fighters (to name a few) are powerful weapons that can generate severe military, political, and psychological pressures when transferred to regions where they have not previously been deployed.

The Persian Gulf War heightened the short-term business prospects for a few U.S. defense compa-

Photo credit: U.S. Army (Frank Trevino)

The Patriot, which became a household name during the Persian Gulf War, is produced under license by Japan and Italy.

Figure 1-10—Arms Exported by Developing Nations, 1978-88



SOURCE: U. S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

nies; however, in part because the United States did not lose major equipment, the war will not reverse the downturn in defense business of the late 1980s or even significantly mitigate it. Defense recession comes at a time when the industry is plagued with overcapacity worldwide. The breakup of the Warsaw Pact, coupled with increasingly cordial East-West relations, makes it very likely that this recession may in fact be a fundamental adjustment to lower levels of defense production across the board.[15]

Photo credit: U.S. Army

The M-60 tank is no longer in production in the United States.

The United States has never viewed arms transfers primarily as a sector in international trade. Indeed, a substantial amount of equipment and training is transferred through various grant programs (see figure 1-11). In addition, the Foreign Military Sales (FMS) program is structured to place foreign policy goals above economic considerations. In an FMS sale, the recipient country makes a formal request to the United States for security assistance, the State Department evaluates the request from a policy standpoint (and may or may not authorize it), and the Department of Defense implements it.[16] In most cases, the U.S. Government then buys the equipment from U.S. companies and transfers it at cost (plus a 3-percent administrative fee) to the recipient nation.

In recent years, however, direct commercial sales (DCS), in which a U.S. company delivers arms directly to a foreign corporation or government, have expanded significantly.[17] In a direct sale, a U.S. company and a foreign government (or firm) reach an agreement and then apply for the requisite permissions and export licenses. Compared to an FMS sale, profits from DCS sales are often higher,

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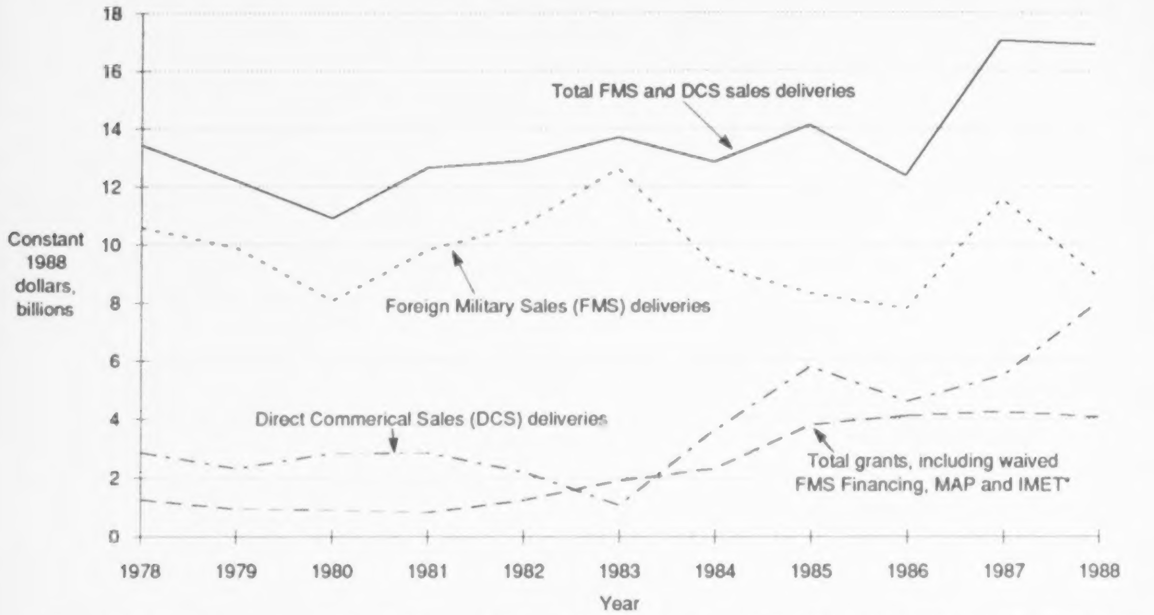
[15] For an overview of issues facing U.S. industrial base planners see, U.S. Congress, Office of Technology Assessment, *Adjusting to a New Security Environment: The Defense Technology and Industrial Base Challenge—Background Paper*, OTA-BP-ISC-79 (Washington, DC: U.S. Government Printing Office, February 1991).

[16] The Defense Security Assistance Agency (DSAA) is the defense agency responsible for implementation of foreign military sales. DSAA may transfer equipment already in stock or it may order additional materiel and defense-related services from U.S. companies to complete the security assistance package. Increasingly, DSAA may also handle licensed production and codevelopment transfers under the FMS program, for example, the FSX fighter program with Japan.

[17] For the purpose of measuring arms transfer activity, the distinction between an arms sale and an arms delivery is important. In the terms foreign military sale (FMS) and direct commercial sale (DCS), the word "sale" means that an agreement to sell has been reached and approved. Some of these "sales" are never consummated, i.e., for one reason or another, they may not result in the transfer of equipment or technology to a foreign country. For this reason, the data in this report refer to equipment or technology that has actually been delivered. Such deliveries often do not occur until 2 or more years after the "sale" is made.

Figure 1-11—U.S. Government and Commercial Sales Deliveries of U.S. Military Equipment, and U.S. Military Grants,* 1978-88



* Waived FMS Financing credits + Military Assistance Program (MAP) + International Military Education and Training program (IMET)

SOURCE: U. S. Department of Defense, Defense Security Assistance Agency, "Fiscal Year Series," Sept. 30, 1989, p. 2.

accountability to the U.S. Government is less, and the overall relevance to U.S. foreign policy goals is usually smaller and less direct. Between 1983 and 1988, delivery of arms under DCS agreements rose by a factor of 6 to reach $6 billion per year (see figure 1-11). These transactions were conducted outside of the U.S. Foreign Military Sales program.

U.S. arms exports have become increasingly contentious in recent years.[18] The FSX fighter codevelopment with Japan, the denied sale of F-15E Strike Eagle fighter-bombers to Saudi Arabia, and the 1990 proposal to sell over $21 billion of assorted equipment to the Saudis are well-known examples. Compared to just a few years ago, the stakes are higher and have expanded to include large amounts of money (and jobs), the future health of U.S. defense companies, the transfer of technology with military and commercial applications, the arming of potential future adversaries, and the proliferation of possibly destabilizing military might.

Principal Findings

Finding 1

As part of their plans for adjusting to a declining U.S. defense budget, many U.S. defense companies are increasing their emphasis on international business. This strategy is being pursued through selling advanced conventional weapons to foreign governments, and increasingly, transferring defense technology to foreign companies through licensed production of U.S. equipment and joint development of new weapons systems. The international operations of U.S. defense companies expanded throughout the 1970s and 1980s, and extensive trade and defense industrial linkages were established around the globe. This process is now being accelerated by a downturn in domestic defense

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[18] Concern over sales to the Middle East extends well back into the 1970s. For example, see Andrew Pierre, "Beyond the Plane Package: Arms and Politics in the Middle East," *International Security*, vol. 3, No. 1, 1978.

Photo credit: U.S. Air Force (M. Sgt. Don Sutherland)

Between 1958 and 1979, 5,057 copies of the F-4 Phantom fighter were produced, of which 1,196 were exported to Egypt, West Germany, Greece, Iran, Israel, Japan, South Korea, Spain, Turkey, and the United Kingdom. The F-4 was also produced under license by Japan.

Photo credit: General Dynamics

The M1A1 Abrams main battle tank is the standard against which all others are measured. However, continued domestic production of the M1A1 is in doubt, because DoD plans to field a Block 3 tank beginning in 2002. The M1A1 is slated for licensed production by Egypt after 1992.

spending and by increased competition from Europe and several developing nations for foreign defense sales.

Finding 2

Expanding international business may increase profits for individual U.S. companies, but for U.S. industry overall the benefits are not so clear-cut. International defense industrial collaboration creates competition for U.S. companies both in foreign markets and at home. Highly capable foreign defense firms, moreover, seek strategic business alliances and subcontracting relationships with American companies as a means of penetrating the U.S. market, which is by far the largest and most lucrative in the world (see table 1-2). Some have acquired U.S. defense firms; more often, they demand a share of the production of U.S. weapons systems and transfer of manufacturing technology as conditions of importing U.S. equipment. Increasingly, international collaboration transfers defense technology to other countries and results in more foreign-made defense components being imported to the United States.

Finding 3

A distinctly economic component has entered U.S. international military sales policies in recent years. In a departure from long-standing practice, high-ranking officers of the U.S. Army and Air Force have recently advocated foreign sales of U.S. equipment—including M1 tanks and F-16 fighter aircraft—as a means of increasing production to keep lines open, or to reduce the unit price.[19] In addition, direct commercial sales (deliveries), which do not involve the U.S. Government as an intermediary buyer, have increased dramatically (see figure 1-11).

Finding 4

Cooperating with foreign industry in the development and production of weapons builds up their indigenous defense industrial capabilities, transferring potent, advanced defense technology to foreign nations. In 1988, the United States was engaged in transferring the production technology for approximately 70 major weapons systems to foreign countries, about the same number as our NATO Allies and the Soviet Union combined (fig-

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[19] In an official response to a direct OTA query the Army stated the following: "Unless specifically instructed to do so by an appropriate official of the Executive branch, the Department of the Army will not encourage or promote sales of U.S. made military equipment to any foreign country. When it is determined to be in the best interests of the Army, to achieve specific stated objectives and benefits to the Army (e.g., to support the industrial base), it is Army policy to obtain such authorization so as to be able to provide support for representatives of U.S. defense industry in their competition for sales of defense articles and services in the global marketplace."

Table 1-2—U.S.-European Defense Industrial Cooperative Arrangements, 1986-89

U.S. firm	Foreign participant	Product
1986		
DY4 Systems	Ferranti (UK)	Technology transfer
Ford Aerospace	Ferranti (UK)	Targeting pod
GTE	Thomson (Fr)	Mobile subscriber equipment
Hughes	MBB (FRG), Aérospatiale (Fr)	Roland I/II missiles
US West	Siemens (FRG)	Network switching system
Six international teams		SDI theater defense study
1987		
Emerson	Agusta (It)	Antitank system helitow
General Dynamics	Aselan (Tk) Dornier (FRG), ENSAB (Sp), Matra (Fr), OTO Malera (It)	Precision guided munitions
General Electric	Thomson (Fr), VDO (FRG)	LCD unit development
Hercules Aerospace	Intermarine (It)	Minesweeper shipbuilding
Martin Marietta	Dowty (UK)	SR antiarmor weapon
RCA-FMC-General Dynamics-CSC-General Electric	Thomson (Fr), Siemens (FRG), British Aerospace (UK), Signaal (Nd)	NATO AAWS bid
Westinghouse	Plessey (UK)	Missile approach warner
1988		
Allied Signal	Ferranti (UK)	Electric generators for Airbus 340 and EFA
Atlantic Research	British Aerospace (UK)	Missile propulsion system
Bendix	Ferranti (UK)	EFA power system (electronic)
Boeing	Thomson (Fr)	LCD instrumentation
Boeing	Thomson (Fr), Plessey (UK)	NATO LADS bid
Detroit Diesel	Perkins Engine (UK)	Engines (defense use)
General Electric	GEC (UK)	Small-medium horsepower turbines
General Motors-Allison	Aérospatiale (Fr)	Allison T-406
Hercules Aerospace	Aérospatiale (Fr)	MOA high-temperature materials
Hughes	Esprodesia (Sp)	Aries missiles
Hughes	Matra (Fr)	SDI study
Lockheed	Lorenz (FRG)	Air defense system bid for Iceland
Lockheed-Sanders	GEC (UK)	Osprey ASW sonar
LTV	Aérospatiale (Fr)	SA 365 helicopter
Magnavox	Ferranti (UK)	SATNAV system bid
McDonnell Douglas	British Aerospace (UK), GPA (Ir)	MD-11
McDonnell Douglas	GEC (UK)	Mast-mounted sight
McDonnell Douglas	MBB (FRG)	Fee upgrade packages
McDonnell Douglas	Royal Ordnance (UK)	30mm ASP system
Teledyne	Eichweber (FRG)	Tank weapon gun simulation system
Texas Instruments	Thomson (Fr)	MOU radar technology exchange
Tracor Aerospace	MES (It)	Threat adaptation countermeasure
TRW	MEL (UK)	PRC 319 HF/VHF radio
1989		
Boeing	Thomson (Fr)	SDI free electron laser
DARPA	DGA (Fr)	Research on reactive armor
Ensign Bickford	British Aerospace/Royal Ordnance (UK)	Explosive products
General Electric	Ferranti (UK)	High-altitude reconnaissance system
General Electric	GEC Ruston (UK)	T-700 engines (Blackhawk)
Hercules Aerospace	BAT (It)	Composite structures
Hewlett-Packard	Dassault (Fr)	Antenna test equipment
Hughes-E-Systems	MBB (FRG)	Arms verification technology
Hughes-Lockheed	Aermacchi (It)	PATS bid
Hughes-Raytheon	MBB (FRG)	AMRAAM production
IBM	Siemens (FRG)	64 megabit chip
ITT	TRT (Fr)	U.S. Air Force radio altimeter bid
Lockheed	Aérospatiale (Fr)	Euroflag
Lockheed	Aérospatiale (Fr)	Long-term MOU (commercial)
LTV	Phillips HSA (Nd)	FAADS bid
LTV	SEP (Fr), AEG (FRG)	ERINT missile
Martin Marietta	Dowty (UK)	ALFS dipping sonar
McDonnell Douglas	Matra (Fr)	Missile/munitions marketing
McDonnell Douglas	Westland (UK)	Apache AH-64 attack helicopter
McDonnell Douglas	Sogitec (Fr)	Mission planning system

Table 1-2—Continued

U.S. firm	Foreign participant	Product
Motorola	Thomson (Fr)	88000/RISC technology exchange
Nasco	Ficantieri (Sp)	Shipbuilding and design
Pratt & Whitney	Aeritalia (It)	Engines
Pratt & Whitney	Airmotive Ireland (Ir)	Test engine cases
Pratt & Whitney	Nordam (UK)	JT8/Boeing 737
Raytheon	Thomson Sintra (Fr)	SQQ-32 sonar
Raytheon-Martin Marietta	MBB (FRG), ERIA (Sp) Bristol (UK), Fokker (Nd), Plessey (UK)	NAAWS bid
Sundstrand	Labinal (Fr)	Auxiliary power system
Teledyne	Fokker (Nd)	F-50 aircraft
Thiokol	British Aerospace (UK)	Rocket propellant
Texas Instruments	Thomson (Fr)	Obstacle evasion sys (ROMEO)
Unisys	Westland (UK), Agusta (It)	EH101 sales (pending)
Westinghouse	Dassault (Fr)	Microprocessor coproduction
Compiled from the following defense periodicals:		
Defense News	Air & Cosmos	Interavia Aerospace Review
Jane's Defense Weekly	NATO's Sixteen Nations	Flight International

Data search conducted by Federal Research Division of the Library of Congress.

SOURCE: Lt. Col. Willie E. Cole, Lt. Col. Richard C. Hochberg, and Comdr. Alfred E. Therrien, *Europe 1992: Catalyst for Change in Defense Acquisition: Report of the DSMC 1989-90 Military Research Fellows* (Washington, DC: Defense Systems Management College, 1990), p. 45.

ure 1-7). This process has contributed to the emergence of numerous centers of advanced defense industry and technology, first in Europe, next in the Western Pacific, and increasingly among developing nations around the globe.[20] Each new center is capable of transferring technology and selling weapons to additional countries (see figures 1-2 and 1-3). The primary result in the aggregate is expansion and proliferation of defense industrial capacity in both advanced and developing nations. The collateral effect is the gradual and collective loss of control over the destination and disposition of potent weapons emanating from many different parts of the world.

Finding 5

All arms-producing nations, except the United States and Japan,[21] have adopted policies: 1) to collaborate with other nations to share development costs, and 2) to export top-of-the-line weapons systems to reach affordable economies of scale because of the high costs of developing new weapons.[22] This trend has resulted in overcapacity of supply and tough competition for sales to foreign buyers. European arms producers, and those of the developing world, export substantial proportions (as much as 90 percent) of their total weapons production (see figure 1-5). Many have long enjoyed strong diplomatic and political support from their governments. In contrast, the United States produces about 90 percent for domestic consumption, imposes unilateral controls on its defense exports, attempts to control retransfer of U.S.-made weapons to third countries, and conducts defense trade in a highly regulated environment. Nevertheless, on an absolute basis, **U.S. exports of both equipment and military technology exceed those of all our allies combined (see figures 1-1 and 1-7).**

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[20] With respect to the Western Pacific region, the Defense Science Board wrote the following: "The U.S. has supported the growth of a strong Japanese defense industry for many years by a policy of unilateral transfer of technology through licensed coproduction of advanced systems. Similarly, with Korea, we have, in effect, encouraged the build-up of an increasingly self-sufficient defense industry. Our policies have been 'successful' but also have created potential problems. They have resulted in capable industries, overcapacity, and with them, high ambitions and expectations for the future. For Korea, this means explicit pressure for third country sales. For Japan, we reiterate the real potential for export of defense-related equipment as incremental relaxations of current government policy may occur with time." Defense Science Board, *Defense Industrial Cooperation With Pacific Rim Nations*, October 1989, p. viii.

[21] While the United States has entered into codevelopment of major weapons systems with its allies, particularly under the Nunn Amendment, it typically has chosen to absorb development costs in favor of domestic development and production for new weapons systems. Japan has chosen to collaborate almost exclusively with the United States, and has prohibited the export of weapons systems.

[22] French Minister of Defense Pierre Joxe stated, "If you want to be able to afford to make your own weapons, you have to be able to sell them." Quoted in the *The Washington Post*, Apr. 6, 1991, p. A17.

Photo credit: U.S. Air Force

The F-16 fighter is flown by 17 air forces around the world and is assembled under license by three foreign nations; 2,006 of the aircraft have been produced in the United States and 510 in Europe.

Finding 6

Wide diversity of supply among both advanced and developing nations has degraded the use of arms transfers—or their denial—as an instrument of foreign policy. The end of the Cold War has reduced a prime reason for arms transfers—to counter those of the Soviet Union. At the same time, however, unilateral U.S. attempts to restrain the arms trade will likely fail because the buyer nation can find alternative sources with competitive defense equipment (see table 1-1).

Finding 7

International arms business, in which the United States is first among several prominent suppliers, is building up a dangerously armed world. In the Middle East, arms imported to the region have raised the stakes associated with political instability and have figured prominently in the calculations of militant religious regimes and regional strongmen. As the Islamic revolution in Iran has shown, once transferred, modern weapons can outlast the governments they were intended to support. As the war with Iraq has shown, arms may outlast the good will of the leaders to whom they were supplied. Highly armed adversaries make it more difficult for the United States to protect its interests, increasingly so in the future if the United States stays its post-Cold War course of reducing its armed forces and defense expenditures.

Finding 8

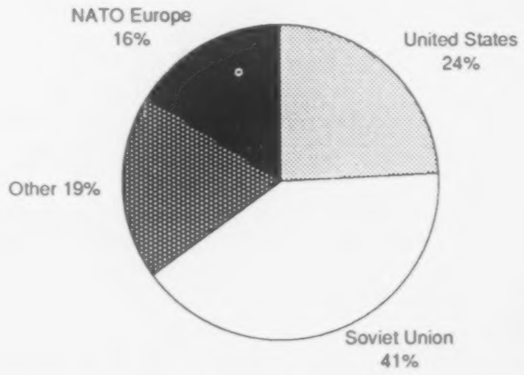
If the goal is to stem proliferation of advanced conventional weapons and defense technology, multilateral restraint by Europe, the Soviet Union, and the United States is a prerequisite. Because these three account for about 80 percent of all arms exports (and a higher percentage of advanced materiel), an agreement to restrain exports could have far-reaching implications (see figure 1-12). In the context of a "new world order," conventional arms control is clearly an alternative to a continuing arms bazaar, especially to the Middle East. Without the stimulus of a polarizing U.S.-Soviet military confrontation, continued proliferation of arms to the Third World has lost much of its military and political justification. Considering its recent role in the Persian Gulf crisis, the United Nations may be the appropriate vehicle to pursue multilateral restraint of defense exports.

Why Congress Should Care

As the defense industries of the world become more capable, the problem of proliferation increases because no single nation (or group of nations to date) can control the ultimate distribution of advanced weapons and the technologies necessary to build them.

The acquisition of weapons and military technology can and does change the balance of power

Figure 1-12—U.S., U.S.S.R., and European Arms Exports as Percentage of All Transfers, 1984-88



SOURCE: U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990), p. 11.

among nations. By exporting large quantities of potent weapons, the advanced industrial states continue to build up the ability of potentially renegade or terrorist nations to threaten the use of force and to invade weaker nations. The Iraqi invasion of Kuwait is the most recent example; if advanced weaponry continues to proliferate at present rates, it is not likely to be the last. Even though the U.S.-led coalition defeated the Iraqi military with unprecedented efficiency and few losses, transferring potent weapons to foreign militaries makes it more difficult for the United States to reduce the size and cost of its military and still protect American interests abroad.

The Persian Gulf War also demonstrated the destructive capability of modern conventional weapons; in less than 2 months, coalition forces devastated the physical infrastructure of Iraq and killed tens of thousands of Iraqi soldiers. This toll in death, destruction, and human suffering may only be the beginning. Even with vastly less military hardware, Iraq's leadership may still devastate the Kurdish and Shiite Moslem populations.

Increasing proliferation of sophisticated weapons and technological know-how has injected new elements of uncertainty and concern into international relations. **The United States and other major exporters are gradually losing control of the weapons transferred as well as the technology and industry necessary to produce and support them.** There can be no assurance that the weapons we and our allies make available to our friends today will not be used against us tomorrow. As the Iraqi situation has presaged, arms trade and collaboration will increasingly influence the environment in which foreign policy decisions are made. If other nations had not armed Iraq, the United States might not have massed so many forces in the Persian Gulf, and the necessity of going to war might have been averted.

Advanced weaponry and defense technology may not always be used for the purposes intended or stay in the hands of the regime to which they were sold. The United States alone sent about $11 billion in military hardware to Iran between 1969 and 1979 and trained over 11,000 Iranian military officers (see figure 1-13).[23] These weapons failed in their purpose, i.e., to enhance the stability of a friendly and moderate regime in the region, and were later used to wage war against Iraq. The Soviets, the French, and several developing nations supplied the Iraqis with a vast arsenal (see figure 1-14 and table 1-3). Those weapons, and U.S. weapons captured from the Kuwaitis,[24] were then available for use against coalition forces in the Arabian Peninsula. Future proposals for defense industrial cooperation between U.S. and European firms will have to be evaluated in light of these circumstances, as well as the comparative permissiveness of European arms export policies.

Photo credit: Hughes Aircraft

U.S. TOW antitank missiles were captured by the Iraqis after the August 8, 1990 invasion of Kuwait.

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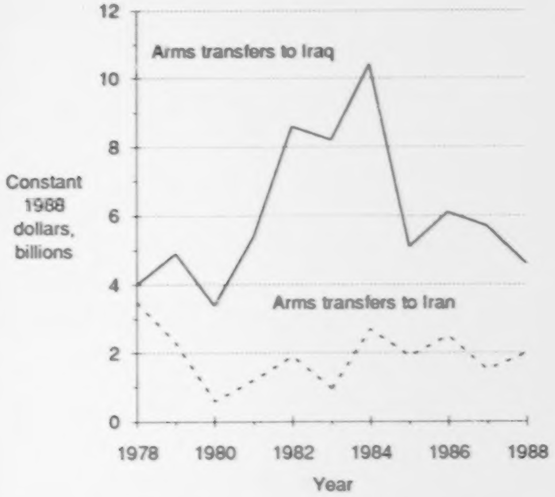
[23] U.S. Department of Defense, Defense Security Assistance Agency, *Foreign Military Sales, Foreign Military Construction Sales and Military Assistance Facts*, Sept. 30, 1989, p. 3; and U.S. Department of Defense, Defense Security Assistance Agency, *Fiscal Year Series*, Sept. 30, 1989, p. 101.

[24] Examples include U.S.-made TOW antitank and Hawk antiaircraft missiles.

Figure 1-13—World Arms Transfers to Iran and Iraq, 1978-88



SOURCE: U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990), p. 93.

As U.S. defense companies adjust to lower levels of domestic production, some important manufacturing facilities may be forced to close. Beyond the immediate economic impact, a great many defense companies that supply parts and components may be adversely affected, with the possibility that the United States could lose crucial defense production capabilities that have taken many years and enormous investments to achieve. Some defense lobbyists see increased international business as a possible partial solution. But there is also the consideration that many buyer nations, especially those with developing defense industries, would likely demand a major share of production, offsetting U.S. gains. Many analysts believe that leaving adjustment of the defense industries to economic forces may produce a defense industry profitable for some companies, but unable to meet the future security needs of the United States. They argue that in the post-Cold War era, the Department of Defense must manage the defense industries efficiently at lower levels of production, and that a policy of selling weapons to other nations just to maintain the U.S. defense industrial base would ultimately fail to address the underlying problems of overcapacity and reduced demand for defense equipment.

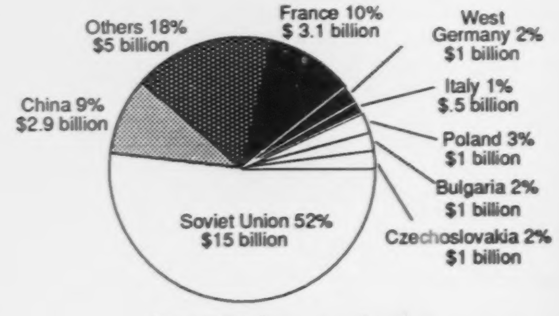
Increasingly, international business arrangements lead to foreign penetration of the U.S. defense market. Typically, a U.S. company (acting as the prime contractor) subcontracts a portion of a defense system to a foreign company. Many foreign defense firms have established a strong marketing presence in the Washington metropolitan area to monitor the U.S. defense market and cement business ties with U.S. defense contractors. In addition, an increasing number of European companies are acquiring U.S. defense firms through foreign direct investment, essentially buying their way into the U.S. market.

Congress has given these activities increasing scrutiny in recent years. Arms transfers constitute a major element in the continuing struggle between Congress and the Executive over how much influence Congress can and should exert over foreign policy. The Executive continues to view and use arms exports as a vital and powerful instrument in the conduct of foreign relations, and Congress continues to assent, sometimes reluctantly, while using its regulatory and oversight powers to influence and circumscribe the foreign policy agenda of the President.

The Policy Dilemma

The state of the international defense business links two issues of current concern to Congress: Controlling the proliferation of modern weapons and defense technology *and* the health of U.S. defense companies. It is likely that a strong consensus could be forged on either issue in isolation; but because of

Figure 1-14—Arms Transfers to Iraq by Country, 1984-88



The United States transferred no arms to Iraq during this period

SOURCE: U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990), p. 117.

Table 1-3—Developing Nations' Arms Exports to Iraq, 1982-89

Brazil	
66	Astros-II SS-30 multiple rocket launchers
20	Astros-II SS-60 multiple rocket launchers
13	Astros Guidance fire control radars
200	EE-9 Cascavel armored cars
300	EE-3 Jacara scout cars
China	
4	B-6 bombers (copy of Soviet Tu-16)
72	Hai Ying-2 ship-to-ship missiles (arming B-6 bombers)
700	T-59 main battle tanks
600	T-69 main battle tanks
650	Type 531 armored personnel carriers
720	Type 59/1 130mm towed guns
128	C-601 antiship missiles
Egypt	
70	F-7 fighter aircraft (Chinese version of MiG-21)
80	EMB-312 Tucano trainers (built under Brazilian license)
150	BM-21 122mm multiple rocket systems
100	Sakr-30 122mm multiple rocket launchers
90	D-130 122mm towed guns
96	D-30 122mm towed howitzers

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

the linkage, the steps needed to implement a solution to one would tend to undermine resolving the other.

Efforts to control proliferation will almost certainly limit the international sales of U.S. defense companies. Similarly, efforts by U.S. defense companies to expand their international operations will exacerbate the problem of proliferation. The problem cannot be solved by a simple choice between constraining arms exports at the expense of a viable U.S. defense industrial base or accepting an arms bazaar in the developing world in order to support that industrial base.

However, with U.S. leadership, at least acquiescence on the part of the Soviets, and cooperation by the Europeans, it may be possible to avoid the potentially catastrophic consequences of arms proliferation to the developing nations. This effort would require multilateral restraint in arms exports. The effects on U.S. industry might be mitigated by moving to a scaled-down U.S. arms production in which technological progress is sustained, adequate readiness is maintained, and profits are possible.

There is general agreement that uncontrolled proliferation of advanced weapons is not in the overall interest of the United States. No one wants regional instability or potent military threats to U.S. interests abroad. But there is less agreement on how much proliferation is too much, where proliferation is dangerous, and to what extent arms transfers can be used effectively as tools of foreign influence.

If the present level of arms exports is maintained, it will add significantly to the proliferation of weapons—both directly, as well as indirectly through the transfer of technology and production capabilities. One suggested approach to controlling proliferation is to restrict further the access of U.S. defense companies to the international market and letting them adjust as the U.S. market contracts. In this view, addressing the problem of proliferation outweighs the business losses of some U.S. companies and the local economies they support.

Many in Congress (and elsewhere) are concerned about economic dislocation that will result from declining domestic defense procurement. Many believe that U.S. defense companies should diversify their business activities into the civilian economy. Some industry spokesmen have argued that because unilateral restraint is unlikely to stem the proliferation of defense technology and military might, the U.S. Government should adopt a policy to help—or at least not hinder—defense contractors. They believe U.S. companies should be allowed to compete vigorously in the international market to increase their profits and maintain production.

Others contend, however, that increased internationalization means that U.S. defense companies will continue to sell technology to foreign governments, ultimately undermining U.S. leadership in the development and manufacture of defense systems—a process that has already taken its toll in many sectors of international trade. From this perspective, U.S. defense companies are national assets, established to serve the national security, whose operation is authorized and subsidized by government, and whose products are paid for with public funds.

As such, U.S. defense firms are obligated to operate under different rules than civil manufacturers; they are not automatically entitled to participate in unbridled international competition. **The development of a truly multinational defense industrial sector, where corporate giants conduct R&D and manufacturing in many countries of the world, would be cause for grave concern. It would be extremely difficult for the United States (or any** other country) to control the dissemination of defense products, and corporate planning might not be tied to the security interests of any single country or alliance of nations. Proponents of this view point to the U.S. experiences in Iran and Iraq as prime reasons strict controls must be applied not only by the U.S. Government but also by our allies.

ISSUES AND OPTIONS FOR CONGRESS

Historical Perspective

The topic of conventional arms exports and controls has a long history, and the relevant legislation and associated government programs are extraordinarily complex. Before turning to a discussion of the issues and policy options raised by the findings of this report, a brief sketch of congressional and executive branch interactions over security assistance and conventional arms control is presented. Those already familiar with this area may wish to skip directly to the next section.

Since the passage of the Foreign Military Sales Act of 1968, Congress has exerted strong oversight and has imposed numerous controls on the military assistance activities of the United States. These have included downgrading or eliminating the Military Assistance Advisory Groups at U.S. embassies, earmarking up to 99 percent of foreign military financing funds for particular countries, and restricting third-party transfers of U.S. weapons under the Arms Export Control Act of 1976, the International Security Assistance Act of 1977, and subsequent regulations (see figure 1-15).

In addition to extensive reporting requirements and regulation of arms exports, Congress has at times mandated outright prohibition of security assistance to countries such as Turkey, Pakistan, and Iraq. Congress has also instituted an elaborate notification process that would enable it to block a proposed sale under exceptional circumstances. These and other requirements reflect the determination of Congress to retain its shared responsibilities in foreign policy and, in particular, its power to regulate commerce with foreign nations derived from article I, section 8 of the Constitution.[25]

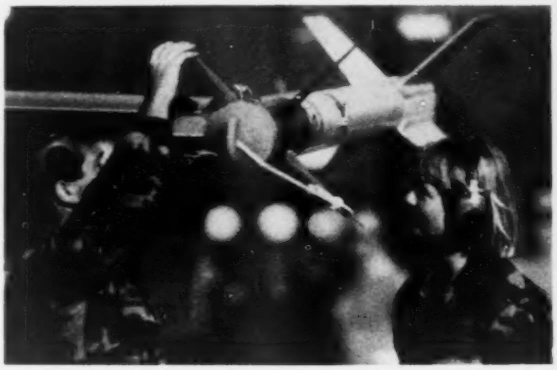


Photo credit: U.S. Department of Defense

The AIM-9 Sidewinder air-to-air missile is produced in numerous versions and is manufactured under license by Germany, Italy, Norway, the U.K., Japan, and Taiwan.

Nevertheless, Congress has rarely intervened aggressively in the U.S. foreign military sales program.[26] As a result, the executive branch has exercised considerable latitude in the definition and conduct of arms sales and the transfer of defense technology. This is evident from the extreme change of policy from the Carter to the Reagan Administrations.[27] President Jimmy Carter saw the transfer of arms "as an exceptional foreign policy implement, to be used only in instances where it can be clearly demonstrated that the transfer contributes to promote our security and the security of our close friends."[28] Four years later, President Reagan took the other extreme approach. Arms transfers would be "an essential element of [U.S.] global defense posture and an indispensable component of its foreign policy."[29]

Although the President has recently proposed that major supplier nations exercise "collective

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[25] Thomas E. Mann, *A Question of Balance: The President, the Congress and Foreign Policy* (Washington, DC: The Brookings Institution, 1990), pp. 4-7.

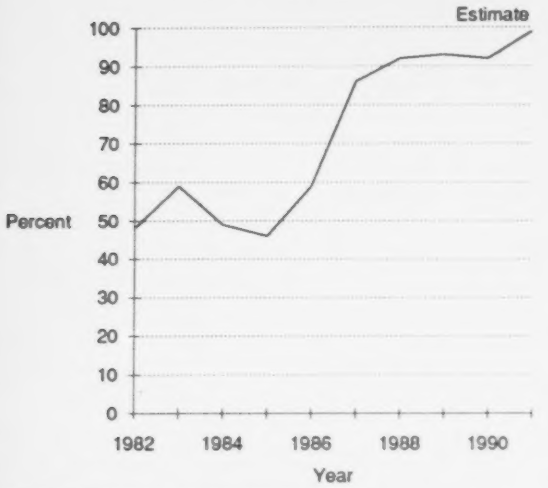
[26] Craig M. Brandt (ed.), *Military Assistance and Foreign Policy* (Wright Patterson AFB, OH: Air Force Institute of Technology, 1989), p. 152.

[27] Andrew J. Pierre, *The Global Politics of Arms Sales* (Princeton, NJ: Princeton University Press, 1982), pp. 52-66; Paul Y. Hammond et al., *The Reluctant Supplier: U.S. Decisionmaking for Arms Sales* (Cambridge, MA: Oelgeschlager, Gunn & Hain, 1983), pp. 266-67; and Christian Catrina, *Arms Transfers and Dependence* (New York, NY: United Nations Commission on Disarmament, 1988), pp. 80-82.

[28] Presidential Directive on Arms Transfer Policy (PD 13), May 13, 1977.

[29] Presidential Directive on Arms Transfer Policy, July 8, 1981.

Figure 1-15—Percent of Foreign Military Grants Earmarked by Congress, 1982-91



SOURCE: Defense Security Assistance Agency

self restraint" in arms sales to the Middle East,[30] the Bush Administration has also taken the following steps to support foreign sales of U.S. defense equipment. It had previously directed U.S. embassy personnel to increase the level of assistance provided to U.S. defense companies,[31] created the Center for Defense Trade within the State Department, and proposed a "defense GATT" that would allow free and open trade in arms and defense technology within the NATO Alliance, and with other U.S. allies.[32] In March 1991, the Administration proposed that the Export-Import Bank guarantee up to $1 billion in commercial loans to members of NATO, Australia, Japan, and Israel to purchase defense equipment from U.S. contractors.[33]

Recent press reports indicate that the U.S. Army and Air Force are for the first time publicly supporting exports of weapons such as the M1A1 Abrams tank and the F-16 Falcon fighter to keep domestic plants running.[34] Prior to May 1991, the Bush Administration had also used weapons transfers liberally in support of its Persian Gulf policies. It proposed the sale of over $26 billion in U.S. weapons to a variety of countries in the Middle East.[35] In his address to a joint session of Congress following the end of the Persian Gulf War, the President pressed Congress for greater latitude in arms transfers.[36]

There is, then, a continuing tension not only between Congress and the Executive concerning arms transfers, but also between the policy of arming our allies and the desire to prohibit the export of advanced weapons and technology to potentially hostile or irresponsible nations. The recent Persian Gulf experience will most likely increase these tensions. The cases presented in this report indicate that despite long-term congressional misgivings and widely divergent approaches by different Presidents, the knowledge and industrial infrastructure necessary to build advanced weaponry is proliferating beyond our control.[37]

In May of 1990, OTA reported that the United States might need to project power into regions and against countries that had been armed by the Europeans.[38] That situation materialized in the Persian Gulf during Operation Desert Storm, when U.S. troops faced weapons produced by some of our European allies. Similar conditions may arise in other parts of the world. It is even possible that, in time, Americans will be sent into battle against troops armed with U.S.-made equipment. In this context, and because the Executive has taken a strong position in support of international arms trade, Congress may wish to address a number of issues affecting policy on arms transfers, international collaboration, defense industrial proliferation, and the future health of the defense industries in the United States.

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[30] *The Washington Post*, May 30, 1991, p. A1, and *The New York Times*, May 30, 1991, p. A1.

[31] Cable from Acting Secretary Eagleburger for Ambassador/Charge on "Guidance Concerning Embassy Role in Support of U.S. Defense Exporters," n.d.

[32] On the "defense GATT," see "The Future of Defense and Industrial Collaboration in NATO," a speech presented by Amb. William Taft to the German Strategy Forum and the Institute for Foreign Policy Analysis in Bonn, Germany, Mar. 15, 1990.

[33] This would require the repeal of section 32 of the of the Arms Export Control Act of 1968. *The New York Times*, Mar. 18, 1991, pp. A1 and D6.

[34] *Defense News*, Dec. 17, 1990, p. 16.

[35] In addition, the Administration has orchestrated forgiveness for $7 billion in past security assistance debts for Egypt and has agreed in principle to permit Turkey to sell 40 F-16 fighters to Egypt if the two countries can reach agreement on the terms of the sale.

[36] The President said, "It's time to put an end to micro-management of foreign and security assistance programs, micro-management that humiliates our friends and allies and hamstrings our diplomacy." Text of the President's address, published in *The New York Times*, Mar. 7, 1991, p. A8.

[37] See chs. 3 through 11 of this report for case studies of particular countries.

[38] U.S. Congress, op. cit., footnote 7, p. 4.

The Spread of Defense Technology and Defense Industry

The first three issues presented below address the question: **To what extent should U.S. policy restrict or permit the transfer of U.S. defense technology to foreign nations?** Licensed production (and other forms of international collaboration) is generally increasing worldwide, and U.S. companies account for a large share of the defense technology being transferred in the West.[39] The implications for the United States of increasing collaboration, however, vary for different partners and also depend on the defense policies and level of industrial development of the individual partner nations. Accordingly, this policy discussion addresses three separate cases: Japan, the advanced European defense producers, and certain developing nations.

Issue 1: Defense Industrial Collaboration With Japan

Part of the genesis of this assessment was concern in the 101st Congress over the proposed transfer of U.S. fighter technology to Japan—as part of the FSX codevelopment agreement. Numerous committees of Congress held hearings on the advisability of permitting General Dynamics to work closely with Mitsubishi Heavy Industries (MHI) to develop a Japanese indigenous fighter. A principal concern was that the FSX project might ultimately help Japan become more competitive in civil aviation markets. But the debate largely failed to address the more immediate questions of whether or not transferring this capability to Japan would enhance or detract from U.S., Japanese, and international security, and what the impacts on U.S. defense companies might be.

In three respects, Japan is a special case. First, the U.S. transfers more major weapons systems to Japan than it does to any other nation. Over the past decade, Japan has embarked on a rapid defense build-up and has developed an extensive defense industrial sector, drawing heavily on licensed production from the United States. Because Japan is a major export market for U.S. defense technology, the FSX codevelopment project represented a deepening of already firmly established defense industrial ties. It also meant business opportunities for General Dynamics and its U.S. subcontractors.

Second, concerns that Japan might proliferate U.S.-licensed, codeveloped, or derivative defense technologies are somewhat mitigated by Japan's policy against export of defense equipment. Although this policy may change, it is anchored in the larger U.S.-Japan security relationship, and to the extent this alliance remains stable, Japanese restraint in defense exports will probably be preserved. If, however, trade relations between the two countries continue to sour, a new security environment could emerge in which Japan depends less on the U.S. security umbrella. Change could also result from different perceptions by the two countries of their roles and interests in the evolving post-Cold War security structure. Japan might decide to do what many U.S. policymakers have urged for decades: take on more of the burden of its own defense. In that case, the United States (and the world) would find a Japan with a strong base of defense technology and an industrial sector fully capable of ramping up production swiftly in the event it was called on to do so.

Third, the flow in defense technology between the United States and Japan has been a one-way street to Japan, with few exceptions.[40] Supporters of the FSX project argued that Japan would make advanced radar and composite materials technology available to the United States under the terms of the agreement. While it is still early in the development process, such reverse technology transfer has not occurred, and some argue that the Japanese developments in question were overrated in the first place. In general, government and corporate leaders in Japan appear eager to receive U.S. defense technology, and at the same time, reluctant to share theirs with the United States.

U.S. policy on cooperation in defense technologies between the United States and Japan should factor in the unique circumstances enumerated above and should not ignore lessons learned from the FSX experience. Mired in political controversy from the outset, the FSX project has encountered unforeseen technical problems and appears to be far more expensive than its Japanese supporters expected. Some now doubt the project will reach full-scale production. Many Japanese officials remain bitter about what they perceive to have been less than good faith on the part of the U.S. Administration and Congress. They believed they had negotiated a firm agreement with the Reagan Administration, only to have it reopened in an atmosphere of distrust and mutual recrimination. These officials now advocate greater caution, both politically and technologically, making it unlikely Japan will soon propose another codevelopment project on the scale of the FSX. Projects involving licensed production (and possibly codevelopment of components) are likely to proceed as in the past.

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[39] See "The U.S. Aerospace Industry and the Trend Toward Internationalization" (Washington, DC: The Aerospace Industries Association, Inc., March 1988), p. 6.

[40] To date, very little Japanese-made defense technology has been transferred to the United States. However, a significant but unknown quantity of Japanese high-technology products (with both civil and military applications) has been incorporated into U.S. defense systems. In general, the degree of DoD dependence on foreign sources of supply is unknown. See U.S. Congress, General Accounting Office, *Industrial Base: Significance of DoD's Foreign Dependence*, GAO/NSIAD-91-93 (Gaithersburg, MD: U.S. General Accounting Office, January 1991), passim.

If maintained, the present U.S. policy to permit frequent transfers of defense technology to Japan will continue to build up the defense industrial base of that nation. This, of course, raises the question of the rearming of Japan. Japan has increased its defense expenditures in real terms by about 6 percent per year for the past decade, and is by far the largest military power in the Western Pacific. Few believe Japan intends to build its arsenals to levels reached during World War II. Nevertheless, a key component of its defense industrial strategy is to produce a large number of major weapons at very low production rates, developing the technological know-how and industrial infrastructure that would have to precede a decision to rearm. **If transferring major defense capabilities to Japan is the intent of Congress, then the present policy should be maintained. If not, Congress may wish to consider prohibitions on future transfers of defense technology.**

Japan is able to reap the benefits of much U.S. defense R&D by essentially buying it through licensed production, while returning little or nothing to the U.S. defense technology base (see table 1-4). Japanese officials believe that technology is a precious commodity and, unlike many U.S. defense industrialists, they see it as far more valuable than short-term economic gains. Nevertheless, those who advocate collaboration argue that by transferring defense technology to Japan, the United States enhances that nation's ability to assume a greater share of its own defense and that U.S. defense companies receive monetary benefits as well. Policymakers will have to balance these benefits against the possibility that Japan could change its defense export policies, and that if it does, as many U.S. defense contractors believe it will, the United States will have helped to create another major supplier (and a formidable competitor) in the international arms market.

Table 1-4—Recent U.S.-Japan Coproduction Transfers

F-15J Eagle fighter aircraft
FSX fighter aircraft
CH-47 D Chinook helicopter
KV-107/2A helicopter
Model 205 UH-1H Huey helicopter
Model 209 AH-1S Cobra helicopter
UH-60J helicopter
EP-3C Orion electronic intelligence aircraft
M-110A2 203mm self-propelled howitzer
Patriot missile battery
MIM-104 Patriot mobile surface-to-air missile
MIM-23 Hawk mobile surface-to-air missile
AIM-7F Sparrow air-to-air missile
AIM-9L Sidewinder air-to-air missile
BGM-71C I-TOW antitank missile

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Issue 2: Collaboration With Western Europe

The major arms-producing nations of Europe—France, Germany, the U.K., and Italy—have long collaborated with one another in the development and production of defense equipment. Some have adopted export-led defense industrial policies, with exports accounting for at least one-third of European defense production.[41] European defense companies are eager to exchange technology with U.S. firms, although historically—because U.S. defense technology was far superior—the United States has transferred a great deal more to Europe than it has received. As OTA has shown, that situation has changed; for purposes of export and collaboration, U.S. and European defense technology and production are now roughly comparable. Many transatlantic subcontracting and joint-venture arrangements are now in effect.[42]

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[41] See figure 1-5 for 1984 exports.

[42] U.S. Congress, Office of Technology Assessment, op. cit., footnote 7.

Powerful political and economic forces have transformed the security arrangements of Europe and challenged the continued relevance and viability of the NATO Alliance itself. Major changes in Soviet policies, German unification, the Treaty on Conventional Forces in Europe (CFE), break up of the Warsaw Pact, economic integration of the European Community, and the Persian Gulf War have all helped to undermine the basic assumptions that have driven East-West security relations in the post-World War II period. While much is still uncertain, many analysts believe Western Europe will become increasingly self-reliant, eventually approaching security concerns not as individual nations or members of NATO, but from the perspective of an independent, single European approach to defense. **Differences in U.S. and European defense industrial and arms export practices will figure heavily in calculating the benefits and risks associated with a U.S. policy to permit or restrict the transfer of U.S. defense technology to Western Europe.**

In the past, U.S. policies to transfer technology and arms to Europe were motivated largely by security considerations and military preparations associated with the Cold War and the threat of a potential Warsaw Pact invasion of Western Europe. Those policies worked. In the space of a few decades, they helped build sophisticated defense industries across Western Europe. These policies also contributed to extreme peacetime overcapacity in the defense industries of the West and to intense international competition for sales of advanced weaponry.

In reviewing the U.S. policy of transatlantic defense industrial collaboration and technology transfer, several factors will be important. Countries with whom the United States has collaborated extensively in the past may in fact transfer weapons and technology to nations that oppose U.S. security and economic interests. In the past, European governments have been willing to export their most advanced weapons to a wide range of countries. Although they were not used effectively in the Persian Gulf War, some of the most sophisticated weapons in the Iraqi arsenal were made in France (see table 1-5).[42] It is not impossible that U.S. soldiers will again face European weapons on the battlefield, weapons that may even incorporate innovations first developed in the United States. **If the European nations and the United States are unable or unwilling to harmonize their defense export policies, then Congress may wish to consider restricting future defense industrial collaboration with Europe.**

Table 1-5—French Weapons Transferred to Iraq, 1981-88

Weapon	Type of weapon	Number transferred
Mirage F-1C	Fighter/interceptor	143
AMX-30 Roland	Antiaircraft vehicle, missile armed	105
AM-39 Exocet	Antiship missiles	734
ARMAT	Antiradar missiles	708
AS-30L	Antiship missiles	1,200
HOT	Antitank missiles	1,600
Milan	Antitank missiles	4,800
Roland-2	Surface-to-air missiles	1,050
R-530	Air-to-air missiles	257
R-550 Magic	Air-to-air missiles	534

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Continued transatlantic collaboration in military technology will likely increase interdependence, both in terms of shared technology and with respect to production capabilities. Such interdependence would deepen penetration of the U.S. market by foreign components and thereby increase U.S. dependence on foreign defense equipment and technology. Dramatic growth in strategic corporate alliances and subcontracting arrangements between U.S. and European defense companies indicate this process is already under way (see figure 1-16). Recent acquisition of U.S. defense companies by European firms, large defense cooperation staffs at the European embassies in Washington, and marketing offices of European defense firms inside the Capital Beltway also indicate increasing European penetration of the U.S. defense market.

European governments are unlikely to permit U.S. defense companies to establish a greater presence in Europe that does not entail reciprocal access for European firms. Because the U.S. Government buys more defense equipment than all of the major defense-producing states of Europe combined, it is **unlikely that opening up transatlantic defense collaboration and trade would benefit U.S. firms in the aggregate, particularly in a declining global defense market.** Over the past several years the defense industries of Europe have consolidated, creating national champions. These defense conglomerates—such as British Aerospace (BAe) in the U.K. and Deutsche Aerospace (DASA) in Germany—are comparable to the larger U.S. defense contractors in terms of financial resources, technology, production, and sales.

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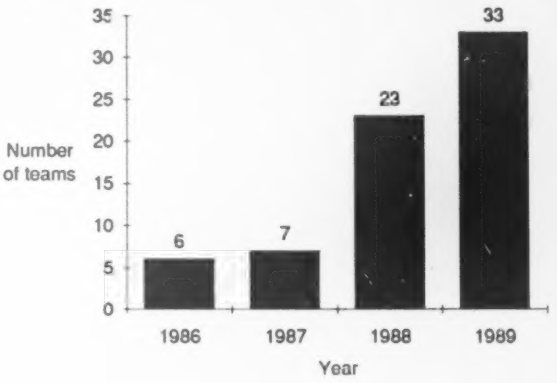
[42] From 1980 through 1987, the French sold $6.7 billion (current dollars) worth of advanced weapons to Iraq, including 143 Mirage F-1C fighters and 734 AM-39 Exocet missiles. U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1988* (Washington, DC: U.S. Government Printing Office, 1989), p. 22.

Finally, the transatlantic exchange of defense technology and the industrial linkages on which it depends raise additional proliferation concerns. Ultimately, the United States exerts very little influence over the weapon systems and defense technology of even its closest allies. **Increasing internationalization of the defense industrial base means that national controls over the distribution of defense systems and technologies become weaker.** At some point in the weapons development process, technology itself becomes fungible, that is, innovations of one company working closely with another contribute to the technology base and knowledge of both. It then becomes possible for either party to build on a particular development, modify it for different applications (both military and civil), sell it in products to third parties, or transfer it as technology to others. Proliferation of defense industry and technology to developing nations is discussed in Issue 3 below.

Issue 3: Transferring Defense Technology to Developing Nations

The developing nations depend far more heavily on transferred defense technology than do Japan and the Western European states. Chapters 7 through 11 analyze the defense industries of seven nations: South Korea, Brazil, India, Taiwan, Indonesia, Singapore, and Australia. They indicate that licensed production is a major vehicle for the promotion and building up of indigenous defense industrial capabilities. While licensed production of components is far more common, several of the nations have also undertaken extensive production of major weapons systems in this way.[43]

Figure 1-16—U.S.-European Defense Industrial Cooperative Arrangements



SOURCE: Lt. Col. Willie E. Cole, Lt. Col. Richard C. Hochberg, and Comdr. Alfred E. Therrien, *Europe 1992: Catalyst for Change in Defense Acquisition: Report of the DSMC 1989-90 Military Research Fellows* (Washington, DC: Defense Systems Management College, 1990), p. 45.

Increasingly, U.S. industry transfers defense technology to a wide range of developing nations on an ad hoc basis in the absence of consistent policy direction. **Congress faces a clear policy choice: whether or not (or to what extent) to permit U.S. companies to build up the defense production capabilities of the developing world.** The principal considerations on which policy in this area might be based are discussed below.

Licensed production and other forms of international collaboration in defense technology are critical to building the defense industries of developing countries. Many of these nations have very weak R&D capabilities in defense technology; and the advanced technology and R&D resources they do possess are usually dedicated to commercial efforts. Defense companies in South Korea, for example, typically depend on the government's Agency for Defense Development (ADD) for most of their R&D, and ADD itself has very limited R&D facilities and programs. **The long-term strategy of the Korean Government is to draw U.S. defense companies into cooperative production and R&D**

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[43] India has produced 21 major conventional weapon systems under license; South Korea, 16; Taiwan, 13; Brazil and Indonesia, 12 each; Australia, 10; and Singapore, 6.

Photo credit: U.S. Air Force

The F-5 fighter has been exported to 32 foreign nations and has been manufactured in South Korea, Taiwan, and Switzerland.

relationships so that Korean firms can learn from their more advanced partners.[44]

In the absence of significant foreign assistance, the indigenous defense industrial capability of most of the developing nations would cease to expand and might even collapse. While there is some evidence that the developing nations are beginning to transfer defense technology among themselves, they are still largely unable to produce the technology or absorb the costs associated with indigenous *development* of modern weaponry.[45] Because domestic demand is so limited, most must find export markets to reduce the unit costs even for systems produced under license. For this reason, U.S. restrictions on third party sales of U.S. weapons produced under license is a major issue for developing countries. They face the same problems of overcapacity and high development costs that have plagued the advanced producers—only for them, the problems are more acute.

Industrial linkages between U.S. defense companies and weapons producers in the developing world have expanded in recent years. Frequently, such linkages are built into the structure of arms sales. What used to be straightforward sales of major platforms have now become sales combined with eventual licensed production of all or part of the weapon in question. These kinds of arrangements contribute to globalization of the defense industrial base. **Global sourcing may already be making defense production more efficient, but in the long term, it will also tend to displace U.S. defense subcontractors (and U.S. workers) and increase U.S. dependence on foreign-made defense products.**

Nations with developing defense industries have brought about a significant expansion of worldwide defense production capacity, which is not surprising considering their growing technological and industrial presence in international civilian markets. These countries are now entering the international arms trade or have active strategies to do so. Some, like Brazil and Israel, have already made their presence felt, exporting (respectively) 90 and 55 percent of their production (see figure 1-5); others, like South Korea, intend to supply a large portion of their own domestic needs as well as those of their allies. Most will likely adopt a dual-use approach to defense technology, i.e., seeking to leverage civilian technology for defense purposes and producing high quality, but not state-of-the-art, weapon systems.

The United States is now engaged in and negotiating transfer of advanced defense technology to a variety of developing countries (see figure 1-8). These include the M1A1 Abrams tank coproduction with Egypt, the Korean Fighter Plane (a General Dynamics F-16 sale and licensed production arrangement), and the Indigenous Fighter Plane with Taiwan (a twin engine fighter based on F-16, F/A-18, and F-20 technology). While the United States cannot stop these nations from building their own defense industries, U.S. policy on transferring defense technology to them will make a very large difference. Of the 16 major weapons systems produced under license by South Korea, for example, 12 were transferred from the United States; and U.S. companies licensed 9 of 13 major foreign systems being produced in Taiwan. It is unlikely that South Korea or Taiwan would have achieved their present levels of defense production without significant and sustained assistance from U.S. defense companies (see table 1-6).

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[44] For example, in the proposed Korean Fighter Plane (KFP) project, an F-16 fighter coproduction agreement, South Korean industry engineers will receive training at research centers in the United States, and General Dynamics engineers will work in Korea to transfer the underlying technologies to Korean companies involved in the project. The Korean strategy is discussed in ch. 8.

[45] These conditions may change in the future for countries as their defense industries mature and they gain experience in introducing civilian innovations into weapons systems, particularly in the field of defense electronics.

Some argue that turning off the U.S. spigot would not solve the problem because the defense industrial base is already global and other nations (particularly in Europe) could provide the requested items. Clearly, U.S. controls on defense industrial collaboration (particularly licensed production and codevelopment) would not eliminate the flow of defense technology unless coordinated with other advanced defense industrial states.

As the largest and most advanced producer of defense systems in the West, a **U.S.-led diplomatic initiative to restrict collaboration might slow the pace of defense industrial and technological dispersion.** It would also place the United States in a position to exert diplomatic pressure on its NATO Allies and the Soviet Union. **Working together, the NATO countries and the Soviet Union could stem the vast majority, perhaps as much as 90 percent, of technology transferred in international defense trade** (see figure 1-2 above). A possible approach is discussed below under Issue 4.

Global Trade in Advanced Conventional Weapons

The final two issues address the question: **What are the key considerations of a policy to restrict or permit arms trade in major conventional weapons?** The Iraqi invasion of Kuwait and subsequent events have focused world attention on international transfer (both sales and grants) of advanced weaponry. On one hand, the Bush Administration has proposed major arms transfers, especially to the Middle East; and the Department of State and Defense Security Assistance Agency (DSAA) have argued to Congress that increased foreign sales are necessary to maintain domestic production of important U.S. weapons systems.[46] On the other hand, the Persian Gulf War also appears to have increased concern among policymakers and the public in the United States, Europe, and the Soviet Union that the proliferation of powerful advanced conventional weapons must be restrained. In France, the fact that French soldiers faced French weapons on the battlefield has catalyzed public opposition to French arms export policies for the first time.[47] **These differing perspectives are likely to form the basis of a major policy debate in the 102nd Congress.**

Table 1-6—Major U.S. Weapon Systems Produced Under License by South Korea and Taiwan

South Korea
F-16 Fighting Falcon fighter (negotiating)
F-5E Tiger-2 fighter
F-5F Tiger-2 fighter
H-76 Eagle helicopter
Model 500MD helicopter
PL-2 light plane trainer
M-101A1 105mm towed howitzer
M-109-A2 155 self-propelled howitzer
M-114-A1 towed howitzer
CPIC type fast attack craft
LCU-1610 type landing craft
PSMM-5 type fast attack craft

Taiwan
F-5E Tiger-2 fighter
F-5F Tiger-2 fighter
F-5F Tiger-2 trainer
Model 205 UH-1H helicopter
AIM-9J air-to-air missile
AIM-9L air-to-air missile
MIM-23B Hawk land mobile surface-to-air missile
M-60-H main battle tank
FFG-7 class frigate
PL-1B Chienshou light plane
Lung Chiang class fast attack craft

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament*.

Issue 4: The Future of Global Arms Trade

Two principal objections are offered to any U.S. policy to place additional restraints on international defense trade. First, some defense industrialists contend that international sales are important to sustain selected sectors of the U.S. defense industries at present levels of production and capacity. Most industry analysts agree that U.S. Government procurement will continue to fall,[48] and that foreign markets, especially in the Middle East and the Western Pacific, offer opportunities for growth. Proponents urge government to support or, at a minimum, permit expanded foreign sales to cushion the effect of declining domestic procurement.

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[46] These include the M1A1 Abrams tank, the Blackhawk helicopter, the MIM-23 HAWK surface-to-air missile, the F-16 Falcon fighter, the AH-64 Apache attack helicopter, and the Boeing 707 aircraft, among others. Several of these were deployed effectively in the Persian Gulf War and are scheduled to go out of production as early as 1993. See U.S. Department of State and U.S. Defense Security Assistance Agency, *Congressional Presentation for Security Assistance Programs*, fiscal year 1992, p. 6.

[47] See *The Washington Post*, Apr. 6, 1991, p. A17.

[48] Salomon Brothers, "Defense Industry Update—The 1992 Department of Defense Budget: Seventh Consecutive Year of Real Decline Is Certain; Backlogs Will Fall," Mar. 18, 1991.

Many analysts argue, however, that contraction in the defense industries is now appropriate, given significant overcapacity both in the United States and abroad. The expansion of the defense industries in the 1980s apparently cannot be economically sustained into the 1990s. As the potential for hostilities between the United States and the Soviet Union has diminished, large defense budgets have become unnecessary and politically unpopular. In this view, a smaller, more efficient defense industrial base can meet the nation's security needs in the post-Cold War era.

The Persian Gulf War has provided support for the view that the United States and its allies must maintain a collective capacity to respond to large-scale military crises in distant lands. But at the same time, the crisis confirmed the growing danger of putting advanced weapons in the hands of governments that may use them for nefarious purposes. Indeed, the proposed $21 billion sale of weapons to the Saudis, and the recent requests by several other Middle East states for substantial arms transfers, take on the character of a self-perpetuating cycle.[49] In this cycle, the United States, the Soviets, and the Europeans must continue to make and export high volumes of weapons to reestablish regional balances of power upset by war or by the last round of weapons sales.

The second argument against placing significant restraints on international defense trade is that unilateral action, while helpful, will be insufficient because the Soviets, Europeans, and other producers of advanced arms would make the sale. Defense lobbyists argue that U.S. industry lost an enormous opportunity when Congress blocked the sale of F-15 fighters to Saudi Arabia in the mid-1980s. As an alternative, the Saudi Government bought between 25 and 30 billion dollars' worth of defense equipment from British companies in the Al Yamamah agreements of 1986 and 1988. In a worst-case scenario, unilateral U.S. action to eliminate foreign military sales might strengthen the competition at the expense of U.S. defense companies, perhaps accelerating a loss of U.S. leadership in a range of defense technologies.

Photo credit: U.S. Navy

The United States agreed to transfer advanced F/A-18 (above) fighter technology to South Korea. After 2 years of negotiations, the South Korean Government decided to produce the F-16 instead.

However, U.S., European, and Soviet policymakers are indicating a new willingness to consider restraint in arms sales to the Middle East, because of the role of foreign arms in the Persian Gulf War and the massive military effort that became necessary to defeat them. In defense trade, governments can exert strong regulatory controls because government is often the only buyer, helps to finance R&D and production costs through progress payments, and has the ability to regulate the output and distribution of the product. **If the goal is to reduce the proliferation of potent weapons, it can be approached as a matter of public policy through concerted multilateral action by the United States and other nations with similar interests.**

Congress could enact stricter unilateral controls through modification of the congressional approval process for foreign military sales and reform of the arms transfer process (Issue 5, below). But this kind of action does not address the fundamental problem—that buyer nations can draw on diverse sources for defense equipment and technology, and that the number of such sources is increasing. The process of creating new centers of defense industry (through increased technology transfer and coproduction arrangements) will deepen this trend if it continues in the future.

With these findings in mind, **Congress may wish to charge the Executive to set up a blue-ribbon commission to develop a U.S. strategy for multilateral agreements on weapons trade and collabo-**

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[49] At this writing $9.2 billion in arms transfers has been authorized. As of Feb. 28, 1991, further sales were postponed pending clarification and review of the political and military situation in the Persian Gulf.

ration—considered in light of U.S. foreign policy interests and global political stability in a new multipolar world. Such a commission would report its findings to Congress and to the President for additional consideration. Congress may also wish to consider the option of mandating that such a commission explore the benefits and risks to the Nation of entering into multilateral talks, perhaps initially limited to the major arms-exporting nations of Europe, the United States, and the Soviet Union. These nations account for approximately 81 percent of all arms transfers (see figure 1-12).

The Persian Gulf situation offers some useful lessons. First, the $2.7 billion in advanced weapons purchased by Kuwait were of little use in defending that nation, and some ultimately fell into enemy hands. Second, the United Nations Security Council moved quickly and effectively to censure and enact sanctions against Iraq as a renegade nation unwilling to live by accepted standards of international conduct. And finally, the end of the Persian Gulf War may improve the opportunity for a comprehensive Middle East peace settlement, perhaps including multinational regulation of defense trade and collaboration conducted within the region.

As President Bush has suggested, the end of the Cold War offers the possibility of "a new world order, where diverse nations are drawn together in common cause to achieve the universal aspirations of mankind: peace and security, freedom, and the rule of law."[50] In this spirit, a congressionally mandated commission could explore the implications of establishing international agreements and institutions to limit proliferation of advanced defense equipment and technology.

In the absence of an institutional mechanism to advocate restraint, however, it is extremely difficult and perhaps impossible for the Executive to resist the use of arms transfers to further its foreign policy agenda. The U.S. Government maintains an extensive bureaucracy in the Bureau of Politico-Military Affairs at the State Department, its embassies, the Defense Security Assistance Agency, the Defense Technology Security Agency, and elsewhere, whose purpose is to conduct international trade in arms such that: 1) the foreign policy agenda of the President is promoted and 2) regulation and appropriate security is exercised over the export of defense systems and technology.

Although extensive guidance for arms transfers is provided through the Arms Export Control Act and related legislation, **Congress has not altered the fundamental principle that it is the policy of the United States to sell, grant, and otherwise transfer large quantities of advanced weapons to other nations.** Perhaps more emphasis should be placed on curtailing international arms transfers through multilateral agreements as part of a larger strategy to pursue objectives that contribute to greater world military and political stability.

Issue 5: Reform of the Arms Transfer Process

There are a number of steps that Congress could take to make the arms transfer process more transparent and accountable for oversight and regulatory purposes.

For example, Congress could change the way in which military assistance, including coproduction and codevelopment, is considered in the authorization and appropriations process. At present, security assistance programs are viewed as an aspect of foreign assistance in the international affairs budget. There is, accordingly, a general understanding that assistance will be extended to allies and others in support of U.S. foreign policy goals. However, because security assistance programs cause proliferation of potent weapons and of defense industrial capabilities, they exert effects on international relations that extend far beyond the immediate support of U.S. allies and friends. **Formally separating security assistance from foreign aid programs in the legislative process would help Congress to weigh the costs and benefits of each to the United States.**

Another means of achieving better visibility for congressional oversight would be to require the Bureau of Politico-Military Affairs to report regularly on the proliferation of conventional defense technology and industry, including a regional assessment of the relative capabilities of different national defense industries. **Congress could also require a "proliferation impact statement" to accompany all proposed arms transfers above a specified dollar threshold.** In addition, Congress could require DSAA to include an evaluation and quantitative analysis of collaborative v. off-the-shelf foreign military sales in the annual Congressional Presentation Document. For major collaborative programs, the Arms Control and Disarmament Agency could also be required to evaluate the extent to which collaboration enhances the defense industrial capabilities of the recipient nation relative to its neighbors or some other standard.

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[50] President George Bush, "State of the Union Message," Jan. 29, 1991. Reprinted in *The New York Times*, Jan. 30, 1991, p. A12.

If Congress wishes to assure that the proliferation aspects of large arms transfers are given greater consideration, it could **establish a high-level nonproliferation office, perhaps in the Bureau of Politico-Military Affairs or in connection with the National Security Council.** The purpose of such an office would be to review all pending arms sales to determine—perhaps on a case-by-case basis—the degree to which the sale would contribute to proliferation and whether it would increase the likelihood of political instability or otherwise damage U.S. interests according to legislatively specified criteria. If the office found the sale not to be in the national interest, it could be charged to make that case to the President as a part of the public record.

Congress could make security assistance programs more accountable by reforming the congressional approval process for arms transfers. **By separate legislation, Congress could require that all arms sales above a specified dollar threshold be approved by a vote of both houses, thus reversing the present process where a sale can be disallowed by the same procedure.** A potential problem is that Congress might then have to bring each of 120 to 130 major sales per year to a floor vote, a cumbersome and impractical process. A variation on this procedure would be to batch the different arms sales according to status of the recipient, sophistication of weapons, regional considerations, volume of sales, or some combination of criteria. In this way the legislative burden of the approval process could be reduced.

In recent years, the number of direct commercial sales (DCS) as opposed to foreign military sales (FMS) has increased significantly (see figure 1-11). Congress may wish to take steps to expose DCS transfers to the same level of scrutiny as FMS transfers. Congress may also wish to prohibit DCS transfers on the grounds that such sales promote direct international linkages between U.S. companies and foreign firms and their governments, and are not subject to the full regulatory review process that Congress has mandated for FMS. **If Congress wishes to slow the pace of the internationalization of the defense technology and industrial base, providing disincentives for DCS transactions would be a useful point of departure.**

Congress could also change the information collecting and processing structure that results in a pattern of specific requests by other countries for arms. Currently, approximately 950 DSAA field staff members work closely with host country military and diplomatic personnel to design security assistance packages that are likely to meet both the needs of the host country and the political requirements at the State Department and within DSAA (see table 1-7). In addition, DSAA maintains separate organizations in 56 foreign countries.[51] Because DSAA field staff are promoted according to how effective they are in arranging and managing security assistance programs in specific countries, they have a career interest in promoting sales and transfers of U.S. weapons.

Congress could change this incentive structure by making the determination of security assistance needs a stand-alone function, to be performed by staff who are not involved in the implementation of the program. It might even be desirable to separate out the determination of needs bureaucratically. This could be done by making the Arms Control and Disarmament Agency, or some other State Department office, responsible for evaluating security assistance needs of recipient countries, both in terms of equipment and industrial capability. This evaluating group might have its own field staff to review weapons transfer requests earlier in the process.

Each year approximately 80 percent of DSAA's operating budget is financed through a 3-percent fee that DSAA charges over and above the cost of the weapons that it procures and then transfers to foreign governments. This self-financing fee has amounted to an average of approximately $330 million per year over the past 5 years.[52] **Because the operating budget of the agency is tied to the volume of weap-**

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[51] U.S. Department of State and U.S. Defense Security Assistance Agency, *Congressional Presentation for Security Assistance Programs*, fiscal year 1991, p. 49.

[52] This figure is derived from data provided by the Defense Security Assistance Agency.

Table 1-7—DSAA Field Staff, 1989-92

	1989	1990	1991 (estimated)	1992 (proposed)
Africa	69	66	64	60
American Republics	195	190	202	204
East Asia and Pacific	249	245	239	239
Europe and Canada	191	173	157	158
Near East and South Asia	265	261	251	251
Total	969	935	913	912

SOURCE: U.S. Department of State and U.S. Department of Defense, Defense Security Assistance Agency, "Congressional Presentation for Security Assistance Programs, Fiscal Year 1991," pp. 53-54, and U.S. Department of State and U.S. Department of Defense, Defense Security Assistance Agency, "Congressional Presentation for Security Assistance Programs, Fiscal Year 1992," pp. 51-52.

ons transferred, there is a powerful incentive for DSAA personnel to make as many sales as possible, consistent with the law and the policy direction and review it receives from the State Department, White House, and Congress. Congress could reduce or eliminate DSAA's self-financing mechanism, thus removing the incentive to maximize sales. At the same time, it would force the DSAA operating budget to come out of general appropriations, increasing congressional visibility and control over the agency's activities.

* * *

There is an emerging consensus that action by any country alone to stem the proliferation of modern weapons and technology is likely to fail. There are too many sources of supply, and for most weapons systems, alternative sources are available. This situation is partly a consequence of past U.S. policy on collaborating with our allies and friends in the production of weapons systems. It is also due, in part, to the liberal defense export promotion policies of our European allies. As a result, we are seeing today the emergence of an increasingly international and interdependent defense industrial structure in the West.

That structure is anchored in a complex set of strategic corporate linkages between U.S. defense companies and their counterparts in the advanced industrial states of Europe and Asia (see table 1-2 and figure 1-16). It is now being gradually extended to numerous developing nations, including Brazil, Taiwan, South Korea, India, Turkey, Indonesia, Singapore, Australia, and others. The result is loss of control over the dispersion of defense technology through the continuous development of new centers of increasingly capable defense industry around the globe.

Chapter 2

Dynamics of World Armaments Production, Arms Transfers and Defense Markets

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Chapter 2

Dynamics of World Armaments Production, Arms Transfers and Defense Markets

The most important macroeconomic force acting on the defense industries of the West is the general decline in military expenditures and procurement levels that began in the United States and Western Europe in 1987, and is expected to continue despite the recent crisis in the Persian Gulf. The most prominent microeconomic force is the rapidly rising cost associated with weapons research, development, and production. The demand for capital to finance new weapons programs will exert increasing pressure on most prime contractors to engage in corporate alliances and joint ventures, and in many cases, to enter into mergers and acquisitions. Some defense firms may also be expected to close.

This chapter provides both an overview of the defense marketplace and a comparative analysis of the defense industries of the United States, Western Europe, and Japan. The United States, of course, remains by far the largest market for armaments, and this is unlikely to change over the next 5 years. However, decreasing levels of procurement in the United States and NATO-Europe will create severe challenges for firms that serve national defense establishments; the prognosis for Japanese procurement is less clear.[1]

In drawing comparisons among countries, this chapter describes the defense marketplace in terms of five key indicators: military expenditures, defense procurement, defense R&D spending, defense industry employment (not military employment), and arms exports. Military expenditures and procurement levels provide the macroenvironment for defense firms. Defense R&D spending indicates the degree to which countries seek to retain an option to engage in the production of modern weaponry. Defense industry employment trends suggest industry expansion or contraction. Finally, arms export trends reveal the extent to which cyclical downturns in defense spending may be offset by overseas sales. Each of these indicators is examined in the analysis of the United States, Western Europe, and Japan that appears below, but first a brief overview of the defense marketplace is presented.

THE DEFENSE MARKETPLACE

The defense marketplace mainly consists of governments that purchase military equipment for their national armed forces from public and private sector armaments manufacturers. The extent to which this equipment is purchased domestically or imported varies widely from country to country.

U.S. and world defense spending peaked in 1987, and has declined in each subsequent year. Particular segments of the defense industry have already felt the contraction. Shipments of U.S. military aircraft peaked in 1987, when 1,199 units, at a value of $24 billion, were delivered to the armed services and to foreign customers. Since then, sales have fallen by 25 percent; in 1989 the industry shipped 1,110 units with a value of $17 billion. According to the U.S. Department of Commerce, aircraft orders are projected to continue their fall until 1992, after which a modest upturn is expected.[2]

In principle, decreases in domestic levels of procurement could be offset by arms transfers. The recent crisis in the Persian Gulf, for example, may result in arms sales for U.S. defense firms of nearly $24 billion over the next 5 years. However, the overall volume of the arms trade has been contracting since 1987.

The United States and Soviet Union supply 65 percent of all armaments in world trade (see figure 1-12 in ch. 1). The armaments they sell have become increasingly sophisticated, while the terms of trade have changed over time. Whereas in the past the major arms producers sold only end items off the shelf (often older weapons sold out of inventories), they now engage in licensed coproduction, codevelopment, and offset arrangements that enable smaller states to build indigenous armaments industries.[3] In turn, these emerging industries, as in Brazil and Israel, have found market niches, allowing them to become exporters in their own right.

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[1] See ch. 6 on Japan.

[2] U.S. Department of Commerce, *Industrial Outlook 1990* (Washington, DC: U.S. Government Printing Office, 1990) pp. 25-26.

[3] U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology*, OTA-ISC-449 (Washington, DC: U.S. Government Printing Office, 1990).

Although the arms trade assumes tremendous importance as a public policy issue, in macroeconomic terms it remains relatively small. During the 1980s, world trade averaged around $2 trillion per year; of that amount $1.4 trillion were manufactured goods. Arms exports constituted about 2.2 percent of all exports. Even for a country like France, which many regard as highly dependent on arms sales for export revenues, the numbers provide a different view. In 1986, France had export sales of $133 billion, and arms sales made up only $4.6 billion of the total. Of all the major exporters, it appears as if the Soviet Union may be most seriously damaged by a decline in export sales.

Of course, arms sales are more important when viewed from the perspective of particular firms or regions within arms-exporting nations. For aerospace manufacturers in particular, exports are often viewed as critical to industrial health. The French firm Dassault, for example, exported over 70 percent of its production, and 32 percent of total French defense production was exported in 1988.[4] With the overall contraction of defense spending and export markets, narrow interest groups may seek the easing of export and arms transfer restraints.

The changing economics of defense are forcing firms to restructure operations in preparation for leaner times. One indicator of this change is employment.[5] Between 1987 and 1989, the U.S. military aerospace industry shed 34,000 workers, or 5 percent of its workforce. Notably, this is far less than the 25-percent cut in sales that the industry experienced during the same period, suggesting that layoffs were postponed. Indeed, in 1990, McDonnell Douglas alone dismissed nearly one-third of its 40,000 workers in St. Louis. Shipbuilding employment has fallen steadily since 1985, and it is projected that over 40,000 workers will be laid off by 1995. The leading European defense firms have similarly shed workers. British Aerospace reduced its military workforce by 13 percent between 1988 and 1989, when 6,000 employees were let go, and the French firm Matra decreased its defense-related workforce by 10 percent. Aérospatiale reports that it has reduced its workforce every year since 1982, with the exception of 1989, when 300 new workers were hired, most of whom were engineers and managers.[6] Of the Western allies, only Japan appears to have increased its defense industry workforce in recent years.[7]

Yet another manifestation of excess capacity in the defense industry is the increased level of merger and acquisition activity (this will be discussed in greater detail below). In 1989 alone the European defense industry witnessed over 30 mergers and acquisitions, while several major deals also occurred within the United States, such as Loral's purchase of Ford Aerospace. To the extent that mergers and acquisitions bring efficiencies to the restructured operations, it is almost certain they will also result in layoffs.

There is, however, an important exception to this portrait of excess capacity—defense R&D. Public officials in the United States, Western Europe, and Japan continue to view certain key technology areas as having insufficient capacity. In Western Europe many new technology programs and projects have been undertaken collaboratively, such as JESSI, ESPRIT, EUCLID, and EUREKA. Technologies targeted for growth include those associated with the aerospace industry (e.g., avionics, propulsion, and acoustics), computation, and electronics. The Japanese have also targeted specific technologies, including superconductivity, optics, advanced polymers, artificial intelligence, and biotechnology. In the United States, the Department of Defense (DoD) has recently published a list of 20 critical technologies, and a plan for promoting development in these areas is now being established.[8] Among the critical technologies are advanced materials, semiconductors, artificial intelligence, and biotechnology. These lists, and the policies associated with technology promotion, provide evidence that public officials seek to build new R&D capacity in many defense-related areas, while shrinking the amount of excess capacity in the production of end items.

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[4] Avions Marcel Dassault, *Annual Report 1989*; Republic of France, Ministry of Defense, *French Defense Statistics, 1989* (Paris: La Documentation Francaise, 1990).

[5] The problems of this indicator, however, should be made explicit. Decreases in overall employment levels may signify greater operating efficiencies rather than reductions in productive capacity. This is especially apparent in Western Europe, where many defense industries have recently been privatized.

[6] Aérospatiale, "Annual Report," 1989.

[7] Society of Japanese Aerospace Companies, *Japanese Aerospace in Figures* (Tokyo: Society of Japanese Aerospace Companies, 1989).

[8] U.S. Department of Defense, Office of the Secretary of Defense, "Critical Technologies Plan," March 1990.

Overall, however, the macroeconomic environment has not been favorable to the defense industry since 1985, and further contraction is likely for the next 5 years. With scarcer resources available for defense, public policy decisions will play a large part in determining which firms and sectors survive, and which fail. The following section discusses the strategy and structure of the defense industries in the United States, Western Europe, and Japan. Each region has particular strengths and weaknesses as it faces the new economic and security environment.

DEFENSE INDUSTRIES: STRATEGY AND STRUCTURE

The ability of individual companies to survive and prosper varies greatly. This section briefly describes the defense-industrial structures found in the United States, Western Europe, and Japan. Notably, American defense firms are the most dependent on defense contracts for their livelihood, while those in Western Europe and Japan are better diversified across commercial and military sectors. At the same time, U.S. military R&D spending dwarfs levels found elsewhere in the Western alliance, suggesting that American firms will not face many foreign competitors in the production of next-generation defense technology.

The United States

An examination of the prime contractors in the U.S. defense industry reveals the following industrial characteristics:

- **Concentration:** Overall, the U.S. defense industry is no more concentrated than many sectors in the commercial world; the top 100 firms account for about 75 percent of overall turnover.[9] However, in specific segments the industry is highly concentrated. Only one firm, for example, produces aircraft carriers; only two firms produce submarines; and only two firms produce jet engines. Seven firms, however, produce airframes, a number that may be too large as aerospace procurement shrinks. In the lower tiers of subcontractors, the industry naturally becomes more diffuse.
- **Annual Budget Process:** Firms make investment decisions using a long-term planning horizon; often 10 years or more. The U.S. Government, however, provides funds for defense procurement on the basis of an annual budget process. As a result, there is a mismatch between project planning and budgeting, which creates programmatic inefficiencies.
- **Defense Dependence:** The prime contractors depend heavily on defense work for their livelihood. Over 70 percent of McDonnell Douglas' sales come from defense, while virtually all of General Dynamics' sales were defense-related. Over $6 billion of Raytheon's $8.7 billion in 1989 sales were for defense, and for Martin Marietta the figures were $5.6 out of $5.8 billion. United Technologies was among the most diversified of the prime defense contractors, relying on government work for only $5.5 out of $19.0 billion in 1989 sales.
- **R&D Intensity:** The United States devoted $38 billion to defense research, development, testing, and evaluation in 1988. The major U.S. contractors each spend between $1 and $2 billion per year on defense-related R&D, about half of which is government funded. This means that firms must come up with substantial sums of cash from operating revenues in order to finance their in-house R&D activities. The ability of American firms to generate needed cash varies greatly. Taken as a whole, however, recent changes in tax policy (especially the treatment of deferred taxes) have greatly constricted cash flow, creating major challenges for defense firms as they look to fund future R&D projects.
- **No Growth in Sales:** This analysis is borne out by DoD projections. DoD is currently projecting real declines in several of its most important procurement categories, and only marginal growth in others.

Declines in defense spending, procurement, and arms sales mean shrinking markets for contractors. The stock market has taken into account the new economic environment, and defense stocks have underperformed the market average by a substantial margin; the outlook for most defense stocks remains poor. Similarly, the bond market has given several of the prime contractors near "junk bond" ratings on their debt.[10] The low stock prices that defense firms are now experiencing create problems beyond those of shareholder value. As capital becomes more expensive for firms, it will be more difficult for them to make the investments required for future research, development, testing, and evaluation, since not all these expenses are reimbursed by government. Further, the decline in equity will make debt financing more difficult to obtain, and more expensive when loans are actually made. To the degree that interest expenses eat up operating earnings, firms will have less cash for fresh investment.

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[9] Jacques Gansler, *Affording Defense* (Cambridge, MA: MIT Press, 1989), p. 245.

This sketch of the U.S. prime contractors suggests an industry that must shed substantial productive capacity in the future. Indeed, even during the military buildup of the 1980s, the capacity utilization rates for defense firms were well below the normal rate of about 80 percent found in commercial enterprises during periods of economic growth. Munitions and aircraft producers traditionally operate at low capacities; often it is argued that excess capacity is necessary to support mobilization requirements.[11] According to a U.S. Air Force study, those prime contractors and principal subcontractors responsible for building fighter aircraft operated at less than 50 percent capacity in peacetime, leaving idle capacity in the event of mobilization. However, capacity is most often measured in terms of utilization rates of plant and equipment. Whether defense firms could find the technical manpower required to meet a sustained surge is a separate issue, and some argue that the United States has little excess capacity in many technical areas.[12]

The Department of Defense has never issued specific guidelines concerning excess capacity; there has been an absence of documents linking military strategy with defense industrial base requirements. But the large excess manufacturing capacity (ranging from over 90 percent in the munitions industry to between 30 and 50 percent in most other segments of the defense industry) increases the costs of defense production, and its availability is a distinct discouragement to firms that wish to modernize the capacity actually in use, or to new firms that might wish to enter defense markets.[13]

Given these characteristics of the industry, what has been its economic response to shrinking markets? First, there has been a trend toward mergers and acquisitions. Prominent examples include Lockheed's acquisition of Sanders Associates in 1986, the leveraged buyout of Singer in 1987, and the 1989 purchase of Ford Aerospace by Loral. Second, firms have engaged in multifirm and multinational teaming arrangements. According to General Dynamics,

> [A]s a result of the increased financial commitments required for new weapon systems, the company is developing teaming agreements to compete for new programs. The company is currently teamed with the Boeing Company and Lockheed Corporation to produce two prototypes of the Advanced Tactical Fighter. The Company, teamed with McDonnell Douglas Corporation, was awarded a development contract for the U.S. Navy's Advanced Tactical Aircraft (A-12). Teaming arrangements with companies in other countries are in place for the M1 tank, U.S. Army's Single Channel Ground and Airborne Radio System and for the FSX fighter aircraft.[14]

The objective of such teaming arrangements has been to share the technological and financial risks associated with R&D and prototype construction and, in the case of multinational teaming, to enter foreign markets.

Third, the industry relies on global sourcing, purchasing an increasing number of components abroad. According to DoD, the import penetration of defense-related goods and services mirrors the import penetration of commercial-equivalent goods and services (with such important exceptions as aircraft). In 1989, for example, defense firms purchased 7 billion dollars' worth of semiconductors. According to DoD, $2.6 billion were imported, or 38 percent. This shift to foreign sourcing of defense goods is relatively new in the American experience.[15]

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[10] Philip Finnegan, "Industry Remains in Debt Downturn," *Defense News*, vol. 5, No. 41, Oct. 8, 1990, p. 4.

[11] John Hiller and Judith Larrabee, *Production for Defense* (Washington, DC: National Defense University Press, 1980), pp. 5-6.

[12] Aerospace Education Foundation, *America's Next Crisis: The Shortfall in Technical Manpower* (Arlington, VA: Aerospace Education Foundation, 1989).

[13] Jacques Gansler, *The Defense Industry* (Cambridge, MA: MIT Press, 1980), pp. 56-57.

[14] General Dynamics Corp., "Annual Report," 1989.

[15] U.S. Department of Defense, *Defense Purchases*, n.d.

Photo credit: U.S. Department of Defense

An M1A1 Abrams main battle tank on maneuvers in Saudi Arabia. General Dynamics, producer of the M1 tank series, has arranged for the M1 to be produced under license in Egypt.

Fourth, defense firms have sought expanded opportunities to codevelop civilian and military products, and to reduce the existing restrictions on commercialization of defense-related technology. Indeed, most of DoD's critical technologies have both civil and military applications. Of the critical technologies receiving the bulk of DoD funding, the four highest priorities—fiber optics, simulation and modeling, turbines, and composite materials—all have "near-term, commercial applications in common. . . ."[16]

Finally, the industry has turned to its traditional outlet during downturns—exports. As suggested above, however, exports are not likely to reverse the trend because a large expansion in foreign sales is not expected, and defense exports average only about 10 percent of U.S. industry's sales. The largest military export item, aircraft, has steadily declined from a 1987 peak of $3.6 billion to a 1990 forecasted level of $1.4 billion. In 1994, DoD projects Foreign Military Sales (FMS) of aircraft to total $1.5 billion, or almost zero growth.

The U.S. industry characteristics and responses described above provide a baseline with which to compare firms in Western Europe and Japan. Each of these areas has distinct strengths and weaknesses. On an individual firm level, it would appear that some foreign companies may be better able to withstand defense spending downturns than their American counterparts, given their relative degree of diversification.

Western Europe

With the end of the Cold War, military expenditures and procurement levels are now in decline throughout Western Europe. In fact, defense spending as a percentage of gross national product has been in decline since 1983. Expenditures in NATO-Europe have fallen from their peak of 3.7 percent of GNP in 1983 to 3.3 percent in 1988. Equipment expenditures as a percentage of military spending have also declined.

However, one fundamental difference distinguishes European defense firms from those of the United States: European firms cannot generally survive on domestic weapons procurement alone. Many American firms rely on defense for over 90 percent of their earnings. Most European companies, in contrast, are far more diversified. British Aerospace relies on defense for 40 percent of corporate sales; Thomson-CSF derives 65 percent of its revenues from defense; Matra is 70 percent defense-dependent; while Aérospatiale is only 44 percent dependent. Notably, in most firms the defense dependency has decreased in recent years; thus, in 1987 Aérospatiale relied on military sales for 55 percent of revenues, while the figure for British Aerospace was 70 percent.

A second difference is that most European defense firms remain much smaller than their American counterparts. In 1989, the largest European firm, British Aerospace, had defense sales of $5.4 billion; the largest American firm, McDonnell Douglas, sold twice that amount (see figure 2-1).

The largest European defense firms appear to spend more on R&D as a percentage of sales than do American companies. In some cases, they reach R&D spending levels that rival those found in the United States. Thomson-CSF, with defense sales of $4.6 billion, spent over $1 billion on R&D in 1989, half of which was internally financed. One explanation for this is that European firms consciously seek

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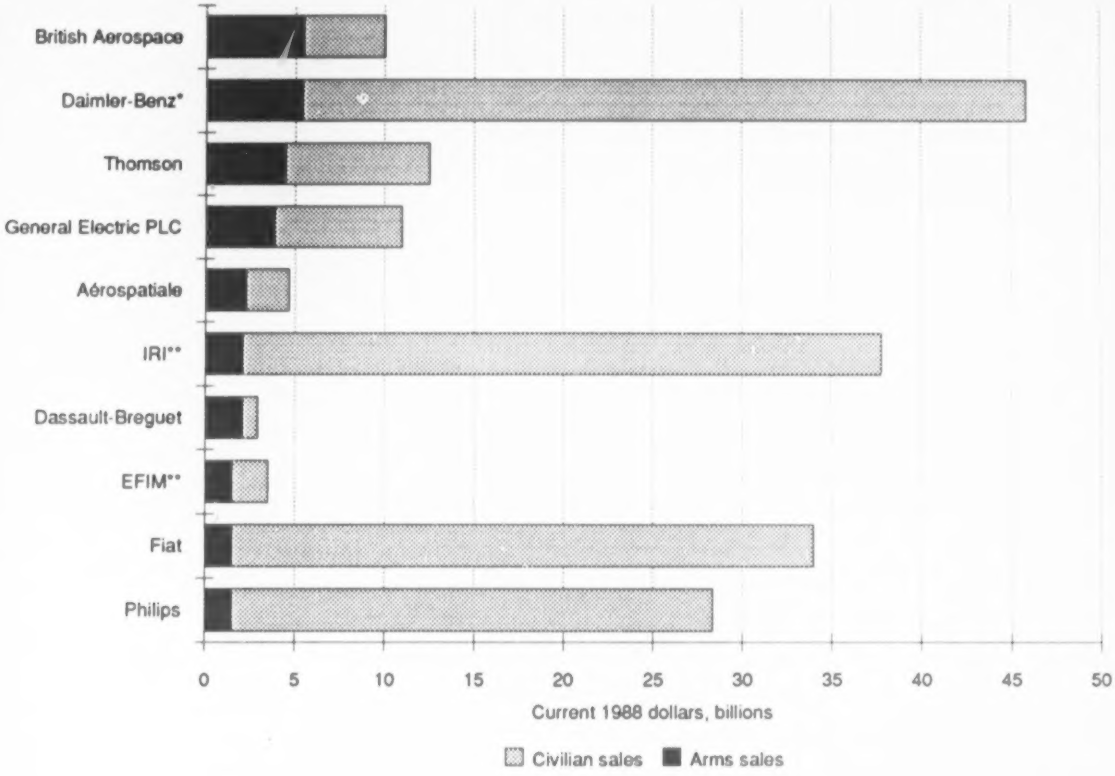
[16] U.S. Department of Defense, Office of the Secretary of Defense, op. cit., footnote 8, p. 10.

Figure 2-1—Western Europe's 10 Largest Defense Companies, by Sales 1988 (current 1988 dollars, billions)



* MBB, AEG, MTU, Dornier, Mercedes

** Holding company

SOURCE: Stockholm International Peace Research Institute, SIPRI Yearbook 1990, *World Armaments and Disarmament, 1990* (Oxford: Oxford Univeristy Press, 1990), pp. 326-328.

to promote spillovers between commercial and military technologies. Nonetheless, taken as a whole the United States dwarfs Western Europe in terms of defense R&D spending. While the U.S. Government spent some $38 billion on research, development, testing, and evaluation in 1988, the comparable European figure was $8.4 billion. This suggests the difficulty that European firms face in remaining competitive across-the-board in military technology, and the need for a "niche" strategy as they seek new market opportunities.

A third characteristic of European defense industries is that they depend on exports. In 1970, France exported 18 percent of its defense production; in 1985 it was 42 percent. By 1987, that number had fallen to 32 percent, and the contraction in export markets was creating financial difficulties for prominent French defense firms, notably GIAT and Dassault (in 1988 Dassault exported 70 percent of its production). The United Kingdom has exported on average 20 percent of its armaments, though the amount decreased in 1988 to about 15 percent, and for certain firms—e.g., British Aerospace—the export dependence has been significantly higher.[17]

The economics of the European defense industry has been neatly summed up:

> . . . [R]apid and costly change, the contraction of traditional markets, the stagnation of European defense budgets in the face of the remarkable

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[17] Figures compiled by OTA from the annual reports of foreign defense corporations.

> American R&D effort: such is the scene confronting Europe's defense industry.[18]

The responses to these economic trends have been threefold. First, Western Europe has experienced widespread privatization of defense firms. Whereas in 1975 few defense firms were in private hands, by 1988 privatization had become the norm in every major country with the exception of Italy and Spain. Recent years have seen the privatization of the giants of European defense, including British Aerospace, Matra, Thomson-CSF, and MBB. This has facilitated the ability of firms to sell inefficient or unprofitable operations, to consolidate activities with other companies, and to engage in widespread competition in a variety of product lines. Further, it has led the firms to diversify their operations; as a consequence, the ratio of defense sales to total sales has, in general, declined throughout the European defense industry.

Second, there has been substantial consolidation. Between 1987 and 1988, 100 defense acquisitions were reported in Western Europe; as stated above, a further 30 major acquisitions occurred in 1989. Of these acquisitions, 70 percent occurred within Europe (mainly within rather than across national borders) while 30 percent were transatlantic. If one objective of European concentration is to create firms the size of their American and Japanese counterparts, this trend must continue. According to one European study, consolidation at this level would require that at least two-thirds of the companies manufacturing major systems be acquired by others. Consolidation is also made manifest in reductions in industrial employment, as reported earlier in this chapter.[19]

Current European projections suggest a possible retreat from defense business. Whereas in 1987 Western Europe's aerospace industry met 28 percent of world demand for military aircraft and missiles, this market share may fall to 23 percent by 2010. Europe's ailing shipbuilding sector has been forced to quit defense work. By necessity if not by choice, the Europeans appear to be engaged in a diversification move away from defense.

Finally, there has been collaboration. The objectives of intra-European armaments collaboration have included strengthening remaining armaments industries by promoting a division of labor, increasing American purchases of European equipment, and promoting the standardization of weapons systems within Western Europe. European collaboration has been institutionalized under the Independent European Program Group (IEPG), which has been vigorously led in recent years by Britain's procurement chief, Sir Peter Levene. Indeed, in November 1988, the IEPG approved an "action plan" that called for the creation of a "common European arms market."

European collaboration has also had a distinctively technological element. Among the collaborative ventures aimed at technology promotion are ESPRIT, JESSI, EUREKA, and EUCLID. The latter has an explicit military orientation, and collaborative projects are anticipated in such areas as artificial intelligence, satellite surveillance and verification, and aeronautics. Collaboration in basic R&D and end-item production have become well established throughout the European Community.

These three responses to the macroenvironment for defense have given European defense firms a degree of flexibility that their American counterparts lack. They are poised to increase their share of civilian markets and to take advantage of the economies of scale associated with the Single European Act. At the same time, they are investing in defense R&D in order to maintain military capabilities. While these capabilities will not be as great as those found in the United States—the United States outspends Western Europe by a 3 to 1 margin in defense R&D—they appear at present to be sufficient given the easing of East/West tensions. Further, since European governments—united or separately—do not appear ready to allow U.S. defense firms to compete on an equal footing for procurement contracts, European companies can continue to enjoy protectionist walls. Indeed, they can benefit from protection not only through greater profits, but by demanding collaborative, technology-sharing agreements with American firms that seek market access; in short, the Europeans are taking a free ride on U.S. military R&D expenditures.

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[18] Francois Heisbourg, "Public Policy and the Creation of a European Arms Market," in Pauline Creasey and Simon May (eds.), *The European Arms Market and Procurement Cooperation* (London: Macmillan, 1988), p. 68.

[19] GRIP, *Memento Defense-Desarmament 1990* (Brussels: GRIP, 1990).

Japan

Japan appears to be the sole member of the Western alliance that views the defense industry as an expanding sector, although there is considerable debate in Japan on the long-term trend. Japan's defense budget has climbed in constant 1988 dollars from a 1983 level of $22.5 billion to a 1988 level of $29.0 billion, an increase of 30 percent. Equipment expenditures have risen from 26 to 28 percent of the budget during the same time period. Among the Japanese government agencies engaged in research and development, the Japan Defense Agency (JDA) enjoyed the sharpest increase in fiscal year 1988, with a nearly 12-percent budget hike. Further, anecdotal evidence suggests that employment in the defense industry is rising. Aerospace employment, for example, has climbed by 11 percent over the past 5 years. Remarkably, defense agency purchases of aircraft increased by 55 percent over the same period.

That Japan has increased its military capabilities cannot be doubted. By 1988, Japan had the third largest defense budget in the world. Nonetheless, Japanese defense expenditures were less than 10 percent of the comparable amount for the United States.

While Japan is not an exporter of defense end-items, its domestic industries do provide the Self Defense Forces (SDF) with over 80 percent of their equipment needs. The largest defense contractor, Mitsubishi Heavy Industries, now derives 17.4 percent of its sales from the military, while the second largest contractor, Kawasaki, has military sales equal to 21.5 percent of sales. In comparative perspective, however, Japanese firms are much less dependent on defense work than their American or European counterparts (see table 2-1).

Table 2-1—Japan's 10 Largest Defense Companies, by Sales 1989 (1988 dollars, millions)

Firm	Defense sales	Defense sales as percent of total sales
Mitsubishi Heavy Industries	3,054	17.4
Kawasaki Heavy Industries	1,463	21.5
Mitsubishi Electric	938	4.7
NEC	596	2.6
Toshiba	573	2.2
Ishikawajima Harima Industries	527	9.9
Nihon Seikosho	261	26.4
Hitachi Shipbuilding	230	8.5
Komatsu	198	3.8
Fujitsu	182	3.8

SOURCE: Office of Technology Assessment estimates, derived from Japan Defense Agency and corporate annual reports.

Although Japan's defense industry has only received close scrutiny in recent years, public policy has been directed toward increasing its capabilities for quite some time. In 1970, the director general of the JDA (and later Prime Minister), Yasuhiro Nakasone, published a blueprint defense industrial policy entitled "Basic Policy for Development and Production of Defense Equipment." In this document, Nakasone outlined five objectives for the industry:

- to maintain Japan's industrial base as a key factor in national security,
- to acquire equipment from Japan's domestic R&D and production efforts,
- to use civilian industries,
- to have a long-term plan for R&D and production, and
- to introduce the principle of competition into defense production.[20]

In the same year, 1970, the Ministry of International Trade and Industry designated "aerospace as one of three key technologies for the twenty-first century."[21]

Over the past 30 years, Japan has sought to develop its aerospace defense capabilities on the basis of collaborative projects with the United States. Mitsubishi Heavy Industries undertook the coproduction of two fighters in the 1970s, the F-4J and F-15J (both designed by McDonnell Douglas), and in the late 1980s it signed an agreement with General Dynamics for codevelopment and coproduction of a new airplane, the Fighter Support/Experimental (FSX). This last project generated substantial controversy in the United States over the costs and benefits of technology sharing with a leading economic competitor.

A distinguishing characteristic of the Japanese military-industrial complex is the dual-use nature of

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[20] Cited in Gansler, *Affording Defense*, op. cit., footnote 9, p. 312.

[21] Richard Samuels and Benjamin Whipple, "Defense Production and Industrial Development," Chalmers Johnson et al., *Politics and Productivity* (Cambridge, MA: Ballinger Press, 1989), p. 275.

Photo credit: General Dynamics Corp.

The General Dynamics F-16 will serve as the foundation for the Japanese Fighter Support/Experimental (FSX) aircraft, which Mitsubishi Heavy Industries of Japan will produce in conjunction with General Dynamics. FSX improvements will include large-scale composite wing structures and an advanced phased array radar.

basic research and technological development. The Japanese Government has targeted certain technologies that are viewed as *key* to both commercial and military enterprise, including those associated with aerospace, artificial intelligence, advanced materials, and superconductivity. As a result, Japanese firms are now important suppliers of high technologies for Western military hardware. For example, the modular technology used in ship rehabilitation is borrowed from Japan, and the bulk of commodity microprocessors are now produced by Japanese firms.

Some American officials and military officers emphasize Japan's contribution to the "arsenal of democracy." One retired U.S. Navy admiral stated in 1987, "all the critical components of our modern weapons systems . . . come from East Asian industries. . . . Certainly, the East Asian industries have really become an extension of our own military-industrial complex."[22] While this statement is clearly an exaggeration, it highlights the growing U.S. military dependence on dual-use, high-technology products as opposed to technology transfer or licensed production of Japanese-made defense components by U.S. companies. Indeed, there are very few examples of the latter.

Despite the dual-use nature of Japanese technology, and the relatively small sums (under $1 billion) that JDA devotes to military R&D, the impact of military procurement on key sectors should not be minimized. Nearly 80 percent of Japanese aircraft (in value) were purchased in 1987 by JDA, for a total of $3.7 billion. Indeed, in the aerospace realm, many of the technological spinoffs that result from research, development, and production can be expected to come from the military rather than the commercial side.

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[22] Cited in James Kurth, "The U.S. and the North Pacific," in Andrew Mack and Paul Keal (eds.), *Security and Arms Control in the North Pacific* (Boston, MA: Allen & Unwin, 1988), p. 35.

In sum, the Japanese defense industry is uniquely positioned to profit from the future economic and security environment. Should the Japanese continue to view defense as a growth industry, the firms have developed the infrastructure necessary for production across a wide range of armaments and components. Should contraction occur, the industries can easily diversify away from defense. Further, with their strength in electronics and other technological areas, the Japanese are well equipped to maintain existing markets overseas and to tap new ones (e.g., Eastern Europe and the Soviet Union) as possibilities arise. While it is unlikely that the Japanese will soon be producing cutting-edge military hardware, this may prove to their advantage as the Cold War becomes history.

Chapter 3

International Operations of U.S. Defense Firms

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Chapter 3

International Operations of U.S. Defense Firms

U.S. DEFENSE INDUSTRIAL INTERESTS

The nature of international markets confronts U.S. firms with a variety of difficulties: global overcapacity, the demand by foreign customers that U.S. firms offset trade imbalances created by large arms sales,[1] and the interest of the United States in checking the worldwide proliferation of defense technology and advanced weaponry.

Global overcapacity exists in many sectors of the defense industries. In civil industry, the typical response to overcapacity is that increased competition drives the less efficient producers out of business. But due to national security considerations, the United States and other nations have chosen to subsidize indigenous defense production. The burden of supporting defense overcapacity has been acute in Europe for many years. As a consequence, European governments engage in extensive international collaboration in weapons development, have adopted lenient defense export policies, and have encouraged their defense companies to produce simultaneously for national consumption and export markets. Because of the rapidly escalating costs of weapons systems and reduced production runs, U.S. defense planners and industrialists are now experiencing similar pressures to reduce the number of suppliers and to share the costs and risks of development more widely—through domestic teaming arrangements and increased international collaboration in defense technology.

U.S. defense companies that seek to export face stiff international competition. In the 1980s there were at least nine fighter aircraft planned or under development, few of which could be expected to recover development costs without extensive foreign sales.[2] The same holds for fully deployed systems. The French Air Force can only afford 35 Mirage 2000 fighters per year, but Dassault, the company that produces them, needs to sell about 75 to 80 per year to make a profit. Moreover, competition will not come exclusively from our allies; countries like Czechoslovakia, Bulgaria, and the Soviet Union, whose defense industries were among their few dynamic sectors, may sell armaments to increase their stores of hard currency.

Foreign customers—including the developing countries—are demanding more of their suppliers. One U.S. defense executive noted that in foreign sales "there is no longer any such thing as an unsophisticated customer." Few foreign nations will buy weapons off-the-shelf from U.S. firms or elsewhere if there is an option to produce all or part of the system at home. To make a sale, U.S. defense companies must offer a variety of incentives, ranging from offsets to licensed production and joint ventures that permit a high degree of local content. Increasingly, U.S. defense executives face difficult decisions concerning how much proprietary technology to share with foreign partners and how to adapt hardware developed for the U.S. military to different requirements. In this respect, the U.S. defense industry is still relatively parochial; U.S. weaponry is designed with the Department of Defense (DoD) in mind, and DoD managers largely determine the design of systems that firms may subsequently market overseas.

The ability of U.S. suppliers to make foreign sales depends as much on U.S. arms transfer policy as on economic factors. The United States is the only major Western supplier whose arms export policies have been primarily motivated by political considerations. Even though economic factors are gaining in importance and U.S. arms transfers dwarf those of Europe, U.S. Government regulation still exerts a limiting influence on international sales of U.S.-made defense products. This takes the form of export restrictions on defense items and technologies that might be militarily useful to potential adversaries, foreign policy restrictions aimed at specific countries, prohibitions against certain sensitive technologies, and a number of international agreements and treaties.

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[1] The term "offsets" is used to cover a variety of arrangements by which sellers direct new or additional purchases to the industry of the buying nation as part of the sale agreement. Direct offsets are directly related to the product delivered to the customer, such as producing a component of the system in question. Indirect offsets consist of the purchase of unrelated products or services.

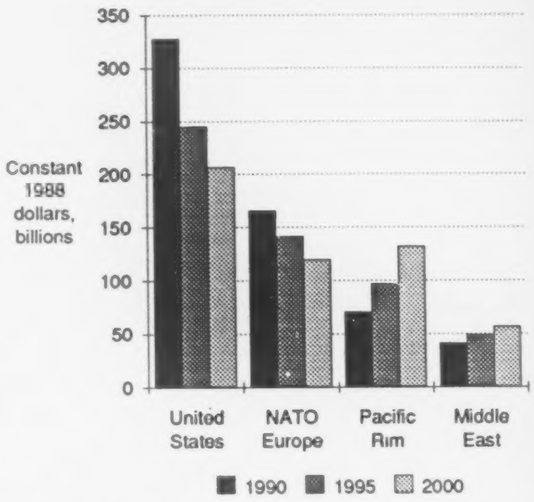
[2] These include the Advanced Tactical Fighter, Israel's Lavi, Northrop Corp.'s F-20 Tigershark, the FSX (Japan), the Korean Fighter Plane, the Taiwanese Indigenous Defense Fighter, the Cheetah (South Africa), the Grippen (Sweden), the European Fighter Aircraft, and the Rafale (France). The Lavi and the F-20 were canceled, and several of the others are in trouble.

The largest potential markets for U.S. defense firms appear to be the Middle East and the Pacific Basin (see figure 3-1). Petrodollars will continue to fund the acquisition of advanced weaponry by a variety of Middle East states. Sales of U.S. military equipment to NATO Europe more than doubled from $1.8 billion in 1978 to $4.2 billion in 1988.[3] (See figure 3-2.) As the European market becomes more integrated, however, U.S. defense sales are likely to decline. While U.S. defense firms will not automatically be locked out of Europe, competition will be intense, probably requiring extensive collaboration with European firms, offset incentives, and reciprocal access to the U.S. defense market.

U.S. defense industrialists and government officials recognize that the days of high-volume, off-the-shelf foreign sales of major systems are over. Many countries that desire U.S. equipment cannot afford it, and future U.S. financing will likely be difficult to obtain. Countries that can afford U.S. weapons, and to whom the United States would sell, like Japan and the European NATO nations, would rather build their own. Finally, sales to countries like Saudi Arabia that can afford what they cannot build are politically controversial in the United States. To increase foreign business, firms will have to plan for the occasional large sale, the internationalization of their operations, and follow-ups to existing sales.

Industry representatives and some government officials complain that the Department of Defense has tended to restrict the export of technologies intended for commercial products; that the Department of State can deny a license for the export of munitions without explanation; and that the Departments of State and Commerce do not coordinate policies in controlling the export of so-called dual-use technologies—those that have commercial and military applications. Nor are these purely interagency difficulties. Within the Defense Department, many potentially direct commercial sales go the government-to-government Foreign Military Sale route because a Defense agency or military Service mandates it.

Figure 3-1—Industry Projection of Worldwide Defense Spending, 1990-2000



SOURCE: Major U.S. defense company.

WHY U.S. FIRMS SEEK INTERNATIONAL BUSINESS

With defense budgets declining and few major development programs on the horizon, many U.S. defense firms will seek additional foreign business. According to one industry association, total defense spending in real, inflation-adjusted terms may drop by 8.5 percent in fiscal 1991, with defense procurement dropping by as much as 21 percent.[4] Industry projections point in one direction: while the United States controlled about 62 percent of the total non-Communist world aerospace market in 1988, its share may drop to 53 percent by 2000 and to just half by 2010. For U.S. defense firms to survive, let alone prosper, without reorganization or industry-wide restructuring, they will have to make foreign sales a larger part of their business—provided that government policy permits it. U.S. Government policy may be the single most important factor influencing the international prospects of U.S. defense companies, especially those that are beginning to think in terms of designing systems with foreign sales in mind.

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[3] At the same time, NATO Europe deliveries to the United States increased from $300 million in 1978 to $800 million in 1988.

[4] These are the estimates of the Electronics Industry Association's 10-year defense forecast. EIA predicts that in real terms total defense spending will drop by 4 to 6 percent a year through 1996. See "Defense Budget Smaller Than Before WWII," *Forbes*, vol. 146, No. 11, Nov. 12, 1990, p. 31.

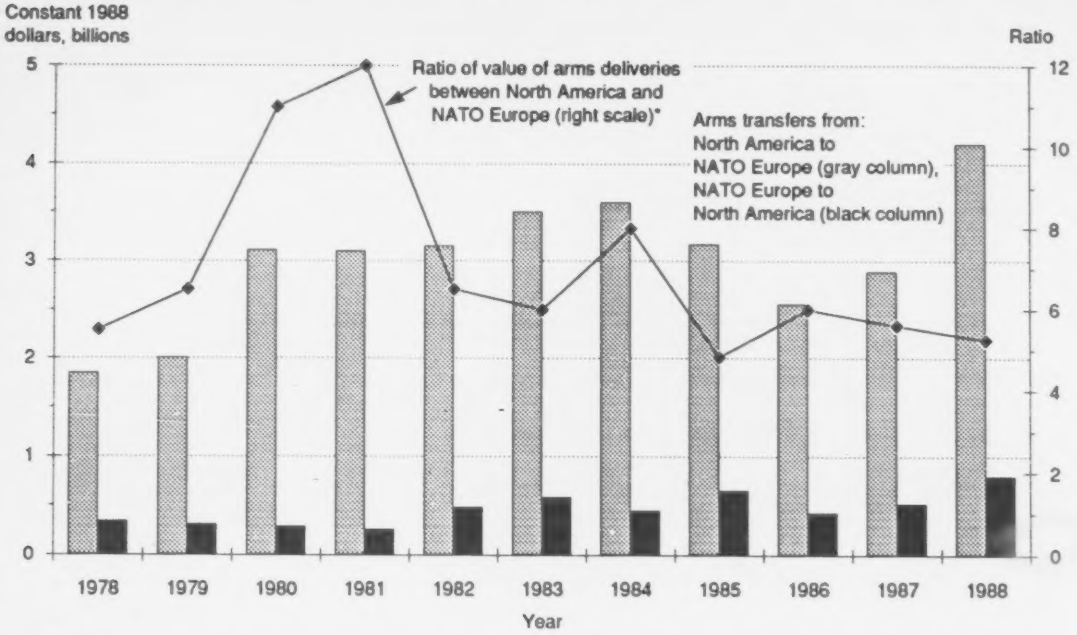

Figure 3-2—Transatlantic Defense Trade, by Value and Ratio, 1978-88

* Example: in 1978, value of arms delivered from North America to NATO Europe was 5 times greater than from NATO Europe to U.S.

SOURCE: Office of Technology Assessment, from data in U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

Many of the larger U.S. firms will start from a small foreign business base. Others, like Boeing and McDonnell Douglas, are heavily involved in international markets, particularly the market for wide-bodied jets; they derive 45 and 23 percent of their revenues respectively from foreign sales, the bulk of which (especially for Boeing) are in civil aviation. But other major firms have a much smaller foreign presence: Grumman (5 percent), Lockheed (6 percent) and Rockwell (16 percent) are typical in this respect. When such firms compete for business in overseas—particularly European—markets, they are at a disadvantage when compared to local firms with substantial operations on the ground. European firms tend to integrate defense and civil business more successfully than American firms, and European industrial policies create greater barriers to market access for U.S. defense companies.

U.S. firms face other obstacles to winning foreign business. The first is lack of access to capital that also hinders their ability to compete in U.S. markets.[5] Defense firms have found it increasingly difficult to raise funds for expansion in capital markets. Because Wall Street does not regard defense as a growth business, firms must pay higher rates to attract investors wary of the risks involved in purchasing their debt. This problem is compounded by many defense firms' inability to explain to shareholders and potential investors precisely what their most sensitive programs are.

Weak capitalization of even the major defense firms makes them vulnerable to takeovers and mergers. Moreover, some companies that might compete successfully in foreign markets are divesting their defense businesses, whether to prevent them from depressing their stock prices, concentrate on their core businesses, or pay the costs of fending off hostile takeovers. For reasons like these, Ford Motor Co. and Goodyear sold their aerospace divisions and Honeywell spun off its defense businesses.[6]

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[5] Unlike the other two obstacles, which are sensitive to regional conditions, lack of access to capital is a *general* obstacle to overseas expansion. Regardless of which markets U.S. firms seek to penetrate, they must be able to raise capital, whether through issuing new stock, raising funds from commercial banks, getting government financing, or selling a portion of the company to investors in return for an infusion of capital.

A second obstacle is the increasing competition that U.S. firms face from foreign producers in such potentially lucrative businesses as defense electronics. Fueled by the consolidation of the European defense industry, companies like Daimler-Benz, Thomson-CSF, and British Aerospace offer product lines competitive with U.S. weaponry and tailored to their customers' needs.

By contrast, most of what U.S. firms sell overseas is equipment originally designed for the U.S. military and then modified for export purposes. U.S. weapons sold overseas are often somewhat less advanced and have less capable black boxes than those sold to the U.S. military. An executive whose company has been quite successful in exporting defense equipment explained that his company "is not in the business of designing systems for foreign customers. It designs systems for U.S. customers that can be sold overseas. What you have in stock at any point in time is what you offer to foreign customers."

U.S. defense industry's performance in fixed-price development programs raises further doubts about its ability to compete overseas; Lockheed wrote off $300 million in losses on the P-7 anti-submarine patrol aircraft, McDonnell Douglas swallowed $72 million in overruns on the C-17 cargo transport, and the Navy canceled its $50 billion A-12 stealth fighter program, for which McDonnell Douglas and General Dynamics were the prime contractors. Some analysts believe these losses and writeoffs will degrade the ability of the U.S. defense industry to compete, and that industry may be losing the know-how it once had to develop next-generation weapon systems.

Despite these obstacles, many U.S. defense executives report they need more foreign business to ensure profitability and, in some cases, survival. They argue that foreign business lowers unit costs of production and increases returns on research and development, and that foreign sales will help to offset declining business at home. Companies also assert that they benefit from foreign government subsidies and that sharing risks for new developments is increasingly necessary, because of the escalating costs of major new weapons systems. Many defense executives believe that if only governments—foreign and domestic—would get out of the way, U.S. industry could dominate world defense markets.

Industry spokesmen tend to minimize the dangers of proliferation of modern weapons and the spread of advanced defense industry and technology. As one industry representative suggested,

> The best thing about the Persian Gulf War is that it established American weaponry as the standard for the region for many years to come and, of course, the United States will have to replace much of the ordnance and equipment expended in the war.

Defense Electronics

Most electronics firms contacted by OTA think they can hold their own in both domestic and international markets. In domestic markets, individual firms believe they can greatly expand shares of a declining market, tailoring semiconductors bought from merchant suppliers for applications such as radar, jamming, night vision, and guidance and control systems for warheads. In international markets, U.S. firms see robust international opportunities for upgrades and retrofitting.[7] In both markets, advanced electronics add value to aging weapon systems; one executive remarked that "a $250,000 black box can protect a $9 million helicopter." But to the extent that a large domestic market remains available, defense electronics firms may feel less pressure than the makers of aircraft and land systems to expand abroad.

While many executives think the potential for international business is enormous, they recognize the difficulties in gaining market share. European firms like Thomson-CSF and the Deutsche Aerospace unit of Daimler-Benz are prepared to go head-to-head with U.S. firms for electronics business. There are fewer and fewer U.S. products for which alternate sources cannot be found; in any case,

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[6] Of course, one firm's divestiture is another's acquisition. Thus Loral, a major supplier of defense electronics, acquired the Ford and Goodyear operations as well as Honeywell's Electro-Optic division. It financed the acquisitions by selling off unwanted assets and borrowing the rest.

[7] See "Defense Budget Smaller Than Before WWII," op. cit., footnote 6. Such a switch, the article continues, will mean less spending on the Strategic Defense Initiative, more light forces, and new fast cargo ships for the Navy.

European governments prefer European suppliers.[8] Many electronic systems embody the kind of advanced technology that triggers export controls and reviews by the Defense Technology Security Administration, the DoD agency charged with reviewing licensing applications for selling controlled items to proscribed destinations. The electronics business is also sensitive to the worldwide decline in defense expenditures that began in 1987.[9]

Land Systems

Land systems like tanks and armored personnel carriers are at the other extreme from electronics. Makers of tanks and other heavy land-fighting equipment, who have traditionally oriented sales to the European front during the Cold War, will not fare well unless they can find international markets.

The experience of General Dynamics (GD), which produces the M-1 main battle tank, is instructive. In the absence of significant foreign sales, GD contends that by 1993 it will have to shut the Detroit, MI, Lima, OH, and Scranton, PA plants that produce the M-1. Company representatives argue that international sales can rescue these plants, preserve an important part of the defense industrial base, and improve the U.S. balance of trade. In testimony before Congress, GD representatives predicted dire consequences if the United States terminated production of the M-1.[10]

GD contends that the United States would face enormous costs in reopening M-1 production lines, once the plants were shut. By GD's estimates, closing the plants would cost the government $200 million, weaken the tank design and engineering community, and force 15 percent of vendors involved in tank production out of business. According to the company, it would take 48 months and cost anywhere from $500 million to $1 billion to restart the industry from a cold base. While some industry analysts dispute these figures, they agree that if M-1 production lines close down, it would be difficult to restart them with less than a year's notice.[11]

GD asserts that international sales would enable it to continue tank production. The company claims that it has a firm commitment for 555 M1A1 tanks for Egypt and that Congress had approved the sale of 315 M1A2 tanks to Saudi Arabia before the outbreak of the Gulf War. According to company officials, filling these orders would also position GD to sell the M1 to the United Kingdom, which was reviewing both the M1 and the Challenger 2 design proposed by Vickers PLC.[12] With the Lima and Detroit plants kept open, GD officials believe they could fill these and other foreign orders and still meet existing commitments to the U.S. Army.

Whatever may be said about foreign competition, the M-1 remains the world's premier battle tank and the weapon of choice for those countries that can both afford it and gain U.S. approval to purchase it. To that extent, the implication of GD's argument—that foreign sales could maintain M-1 production lines—may be valid.

But making domestic production depend on foreign sales would create many problems. An alternative strategy to produce M-1s and comparable systems in smaller quantities would obviate the need to find overseas markets, avoid the risk of having to sell there in order to recover R&D and production costs, and mitigate the overcapacity problem. The proposal to use foreign sales as a way to sustain excess M-1 production illustrates a fundamental policy dilemma facing the U.S. Government. The primary purpose of the U.S. defense industries is to meet U.S. military and national security requirements. A policy and an industrial structure that depends on foreign sales to make the manufacture of defense systems profitable (or even possible) would create strong pressures on DoD and the State Department to approve foreign sales that could not stand on their own merits.

Military Aircraft

U.S. aircraft and engine manufacturers are also counting on international business to keep production lines humming. GD originally tooled to build 216 F-16s per year; for several years, it was building

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[8] In its 1989 report, the Defense Policy Advisory Committee on Trade observed that "there are few U.S. products or technologies which are not now available from other sources." Defense Policy Advisory Committee on Trade, *Year-End Review, 1989*, p. 10.

[9] Rick Whiting, "Tracking the Changing Defense Electronics Market," *Electronic Business*, vol. 16, No. 17, Sept. 3, 1990, p. 31.

[10] Prepared statement by General Dynamics for House Appropriations Subcommittee on Defense, June 21, 1990, p. 4.

[11] Eric Deritis, "Army Phases Out M1 As Budgets Shrink," *Government Executive*, vol. 22, No. 8, August 1990, p. 92.

[12] The British Government was also reviewing the French LeClerc and the German Leopard.

300 planes a year at its Fort Worth and overseas plants, a figure that has dropped to 72 and may fall as low as 48, according to a Congressional Budget Office estimate. Thus GD's Fort Worth Division is counting on foreign sales, which now account for 40 percent of revenues.

Many suppliers of aerospace systems find themselves similarly situated. It now costs between $1 and $2 billion to develop an advanced aircraft engine, and considerably more for a fighter plane like the Advanced Tactical Fighter. Under such circumstances, firms are increasingly forced to enter into domestic teaming arrangements and to seek international joint ventures and sales.[13] For U.S. markets, teaming enables the partners to share development costs that neither could handle alone. International teaming and joint ventures might help cover development costs and allow U.S. firms access to markets that might otherwise be closed to them. They may also help to ensure an up-front commitment by a foreign government to a minimum purchase of a jointly produced weapon system. Reasons such as these led General Electric and the French firm SNECMA to establish CFM International, which is developing the CFM56 engine; Textron to team with Boeing to develop the V-22 Osprey; and McDonnell Douglas and British Aerospace to collaborate on the Harrier AV-8B vertical takeoff-and-landing plane and the T-45 Advanced Jet Trainer.

The history of U.S. aerospace exports has followed a well-defined pattern. Most early international sales did not involve much foreign company participation. As foreign customers became more sophisticated, they demanded direct offsets, coproduction, or both. Thus early F-15 sales to Israel involved 25 percent offsets, while the last five involve 50 percent. In the case of Japan, McDonnell Douglas negotiated two major licensed coproduction agreements with Mitsubishi Heavy Industries, the second of which is for the production of 217 F-15J aircraft through 1995.

U.S. firms have accepted collaboration in various forms because it is often the only way to sell to Europe, Japan, Israel, South Korea, and other nations with sophisticated defense needs. Most countries wish to be as self-sufficient in defense production as possible. To this end, countries (and companies) insist on collaboration as soon as possible (often with direct offsets of components) in lieu of direct buys. That is why U.S. firms concede that it is basically unrealistic to expect Japan or the European nations to buy finished systems.

Many U.S. firms assert that technology transfer issues are red herrings. Because planes like the F-15, F-16, and F/A-18 are fully developed fighters, they contend that no transfer of development technology is involved. According to industry sources, the proposed sale and licensed production of 120 F-16 fighters to the Korean Air Force involves normal U.S. Government controls and licensing procedures, offset credit requirements will be limited to 30 percent, and there will be no "directed buy-backs"—that is, U.S. purchases of components coproduced by the Koreans[14] Most defense firms assert that, even in the absence of U.S. Government controls, they would not license their most advanced technologies to other nations.

However, coproduction always leads to the transfer of some manufacturing technology and often stimulates the development of indigenous defense industries. DoD has been sufficiently concerned about the risk of transferring sensitive technologies to South Korea that it prepared a list of items that must be procured as U.S. industry-supplied end items through government-to-government Foreign Military Sales (FMS). The initial "FMS Must" list included engine hot sections, computer source code, inertial navigation hardware, and classified radar hardware technology. Thus, while DoD attempts to stem the transfer of sensitive technologies to foreign customers, the very nature of coproduction makes it difficult to avoid such transfers.

Second, there is consensus that for all the constraints associated with arms transfers, international business is still very profitable for U.S. firms. Whether the transfer occurs through foreign military sales arranged by DoD or through direct sales to the end user, firms engage in the business because they can make money. One large contractor claimed that although foreign sales were only 11 percent of revenues, they accounted for 25 percent of profits. For another firm, the figures were 15 and 33 percent; while an executive in the electronics group of one large firm asserted that international sales accounted for 40 percent of the group's profits, about 20 percent of total business.

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[13] No one is yet suggesting that next generation systems such as the ATF should be designed with export markets in mind.

[14] Under a U.S.-Korean Memorandum of Understanding, negotiated with McDonnell Douglas' F/A-18 in mind, the Korean Fighter Program would occur in three phases. Phase I would entail the sale of 12 off-the-shelf aircraft under a Foreign Military Sale; under Phase II, Korea would buy 36 U.S-built kits and assemble them under license; in the final phase, for 72 aircraft, most of the components would be built in the United States and assembled in Korea under a limited commercial license. Similar terms will likely obtain under the new agreement South Korea has made with General Dynamics for production of its F-16 fighter.

Many of the larger firms contacted by OTA believe that foreign business will be important to their continued profitability. The lack of new domestic defense business and the risks associated with getting what remains have made foreign business even more attractive. Executives at U.S. firms believe that they can win foreign business. Going after it presupposes several things: a willingness to engage in joint ventures, to accept some kinds of offsets even if they make little economic sense, and to license technology that may be close to state-of-the-art. U.S. firms recognize that, in collaborating, they may be nurturing future competitors. But as one U.S. executive remarked: "Everyone you do business with is a potential competitor."

THE INTERNATIONAL MARKETPLACE

According to industry sources, there are three foreign markets whose size and buying power make them attractive to U.S. defense firms: Europe, the Pacific Rim, and the Middle East, with most of the prospective business expected from the latter two. Although U.S. firms continue to market in Europe, the obstacles they face are formidable. These include the consolidation of the European defense industry, leading to firms like the Daimler-Benz group, Thomson-CSF, General Electric PLC (U.K.), and Aérospatiale, which offer a full line of defense products; and the reluctance of European governments to accept outside suppliers unless they can offer a product clearly superior to anything European firms can provide.[15] In this environment, outside firms must collaborate to have any chance of winning contracts.

These trends are already firmly established, as McDonnell Douglas' collaboration with British Aerospace on the Harrier II and T-45 trainer and General Electric's CFM venture with SNECMA suggest. The T-45 is especially interesting because it is being built in the first instance for the U.S. Navy. Collaboration gives McDonnell Douglas access to foreign capital and positions it to sell the product to other countries. British Aerospace is responsible for the airframe, Rolls Royce for the engines, Hughes Aerospace for the aircraft simulators, and McDonnell Douglas for systems integration and production.[16]

More than the Americans, the Europeans accept that they are producing both for indigenous markets and for export. Their own markets are too small to absorb the quantities their manufacturers must produce in order to recover their R&D and production investments. Marketplace realities dictate that the same firms that collaborate with U.S. companies on European procurements will compete with them for contracts elsewhere.

The history of France's Mirage III and Mirage 2000 fighters illustrates how the need to export drives arms production. In 1977 Dassault-Breguet produced 162 Mirage IIIs, only 44 of which were procured by the French government; the other 118 were exported. The same holds for the more advanced Mirage 2000. Since the French Air Force can only afford 35 of these aircraft per year, the company must find other buyers for the additional 75 to 80 planes it produces annually. Orders from India, Egypt, Greece, Morocco, and the United Arab Emirates have permitted economies of scale in production. With the French Government prepared to underwrite only 80 percent of the indigenous procurement costs of weapons, the balance and profit must come from foreign sales.[17]

Even when blessed by government, U.S.-European collaboration can be risky. Some of the most ambitious cooperative ventures are in serious trouble. The Advanced Short-Range Air-to-Air Missile is in jeopardy as the U.S. Air Force prepares to withdraw from the program; both Hughes Missile

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[15] It was this consideration that led the British Government to choose Westinghouse's AWACS radar system over British Aerospace's Nimrod on technical grounds. The other factor was that Westinghouse offered 130 percent offsets.

[16] The partners in the T-45 program have formed a joint marketing committee to discuss international sales opportunities.

[17] Information on Mirage III and 2000 from David J. Louscher, "Patterns of Demand and Supply of Weapons Systems," a presentation prepared for the Workshop on Arms Transfers to the Middle East, OTA, International Security and Commerce Program, Sept. 21, 1990. Several of the fighter planes cited in footnote 4, as well as France's LeClerc main battle tank, will also require foreign sales to recoup their R&D and production costs.

Systems Co. and BAe are presenting an alternative to Britain's Ministry of Defense to revive the program. Similar problems affect the production of Patriot missiles in Italy, as funding constraints there threaten Raytheon's collaboration with Fiat Aviazione and Selenia. All of this is in addition to the problems of those European ventures that have some U.S. content, above all the European Fighter Aircraft (EFA). Germany has requested analysis of the potential cost of withdrawing from the EFA program, while Italy is seeking additional funding to cover its share of R&D.

U.S. firms doing business in Europe will be fortunate to maintain the business they have. Given global overcapacity, the pressures on European governments to maintain their defense industrial base, and the acquisition of smaller European firms by the larger ones, U.S. firms will find it difficult to increase their current market share. The efforts of the Independent European Programme Group to promote armaments cooperation have also affected U.S. prospects. One U.S. executive noted that while IEPG "was intended to make European firms more efficient, locking the United States out was a secondary, but welcome, effect."

Pacific Rim nations, including Japan, present greater opportunities and other difficulties. Both Japan and the Republic of Korea have sophisticated production capabilities, although Japan, with its formidable R&D infrastructure, is by far the larger and more important.[18] Even more than with the Europeans, weapons transfers to Japan, South Korea, and possibly Singapore, Indonesia, and Taiwan raise issues of technology transfer. Both Korea and Japan have growing indigenous defense industries; and although Japanese policy does not currently permit the export of arms, many U.S. executives told OTA they expect that by the end of the decade Japan will be a major competitor, especially in defense electronics.

The long-term prospects of U.S. firms in the Pacific Rim are problematic. Their traditional role as suppliers to Japan and South Korea is an advantage; it may well lock out European firms, since many Japanese and Korean weapon systems are produced to U.S. specifications. But the FSX controversy raises the issue of whether—and if so, for how much longer—these nations will be willing to depend on outside sources for weapons development.

Photo credit: Raytheon Co.

Raytheon Co.'s Patriot missile defense system is produced under license in Japan and Germany, and Italy has negotiated to produce it as well.

According to a General Accounting Office official, the sale and licensed production of advanced U.S. fighter aircraft with South Korea is only the first phase of an ambitious program to develop an advanced indigenous armaments industry. The second phase would be a follow-on codevelopment, while the third would lead to an indigenous fighter. Although many observers consider these goals unrealistic, several U.S. defense industry executives conceded that Korea could become a significant producer of aircraft parts and components in the world market.

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[18] On Japanese defense programs, see U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology*, OTA-ISC-449 (Washington, DC: U.S. Government Printing Office, May 1990), ch. 4, pp. 61-72. For South Korea, see ibid., app. D, pp. 111-113.

The Middle East is the largest and most problematic remaining armaments market. According to the U.S. Arms Control and Disarmament Agency, in 1988 the region as a whole imported about $15 billion in arms, accounting for 31 percent of all arms transferred that year.[19] Between 1984 and 1988 the Soviet Union supplied about one-third of all arms imported to the region, with the United States (18 percent) and France (14 percent) second and third, respectively. During the 1984-88 period, Iraq, Saudi Arabia, Iran, and Syria were the region's largest importers.[20]

In selling to the Middle East, the United States will face competition not only from Britain and France, but the Soviet Union and the People's Republic of China as well. The competition will be shaped by the fact that, except for Israel (and to some extent Egypt), none of these countries has an indigenous development, production, or support capability. In effect, when the United States or Britain sells to Saudi Arabia, each must provide a complete weapons package that includes spare parts, logistic support and other support services. U.S. companies, however, may enjoy a significant advantage in the future, because of the performance of U.S. weapons in the Persian Gulf War.

Israel presents a special case because it is the only regional power with a major defense industrial capability. It is also the only country with which the United States has an agreement for directed offsets; that is, U.S. suppliers to Israel agree to purchase specified offset amounts of equipment from Israeli firms. Further, Israel has tried to develop its own weapon systems even when, in the view of some industry and DoD officials, it would have made more sense to buy products off-the-shelf from U.S. suppliers.

There is, then, a certain tension between Israel's defense needs and its willingness to rely on outside sources to satisfy them. To the extent that Israel relies on a single supplier country, as it did on France until the 1967 Six Day War, it faces the risk of being cut off if political conditions change. The Israeli desire for indigenous production capacity is thus motivated by more than nationalism; up to a point, it is a rational response to the political realities it faces. Chapter 5 of this report provides a detailed description and analysis of the Israeli defense industries.

The problems U.S. officials and suppliers face with Saudi Arabia are of a different order. With virtually unlimited amounts of cash, the Saudis are in a position to buy what they want—if not from the United States, then from elsewhere. In connection with the 1986 and 1988 Al Yamamah sales by Britain of 25 to 30 billion dollars' worth of weaponry to the Saudis, one observer noted:

> The fact that Saudi Arabia—a country that 20 years ago would only have been able to buy obsolete stock from the arms manufacturer's bottom drawer—is able to buy such modern weapons is a mark of how rapidly the market has changed. As the Saudi deal clearly showed, the amount of leverage that the supplier countries can now impose on the buying nations is much less. In many respects, power has now moved from the seller to the buyer. Hard bargains can be struck and barter is the common currency.[21]

More than in the European and Pacific markets, the effects of U.S. sales to the Middle East will ripple throughout the region. Sales of F-16s to Belgium and the Netherlands raise no major political issues because they conflict with no other regional security interest; even the proposed F-16 fighter sale to South Korea is fairly straightforward inasmuch as the threat to that country is clear-cut.[22] But a sale to the Saudis must be weighed against other, equally important regional interests. To counterbalance the Saudi sale, the Administration announced that it was *immediately* sending Israel two Patriot air defense units, as well as a promise of more munitions, 15 F-15s, and 10 CH-53 Sea Stallion cargo helicopters. Thus a sale to one country triggers sales to others in the region.

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[19] U.S. Arms Control and Disarmament Agency, *World Military Expeditures and Arms Transfers 1988* (Washington, DC: U.S. Government Printing Office, 1990), pp. 7, 75.

[20] U.S. clients included Saudi Arabia, which bought $5.8 billion, Israel ($6.1 billion), Egypt ($2.8 billion) and Jordan ($0.5 billion). Ibid., p. 9.

[21] James Adams, *Engines of War: Merchants of Death and the New Arms Race* (New York, NY: The Atlantic Monthly Press, 1990), p. 126.

[22] The debate over the FSX presents a different kind of issue, since that debate focused almost entirely on technology transfer rather than the military merits of the plane.

FOREIGN MILITARY AND DIRECT COMMERCIAL SALES

U.S. foreign and national security policies shape the procedures by which weapons are actually sold: foreign military sales negotiated by the Defense Security Assistance Agency (DSAA) and direct commercial sales by U.S. firms. This section reviews the impact of both on U.S. defense firms.[23] The merits of each procedure matter because each has its own effects on the overall pattern of activities in international defense business.

An FMS is a government-to-government transaction in which a foreign government transmits a letter of intent to purchase a specified weapon system. It is similar to a domestic procurement inasmuch as the same regulations cover both. Following a Planning and Review cost analysis, DSAA may then issue a Letter of Offer and Agreement setting forth the terms under which the equipment will be sold, followed by the procurement and delivery of the items requested by the foreign government.

Increasingly, foreign governments are willing to deal directly with U.S. suppliers, although FMS remains the principal conduit for the export of U.S. weaponry. Figure 3-3 illustrates that while direct commercial sales deliveries have increased dramatically, they have not yet superseded FMS as the principal means of transferring arms to foreign buyers. In general, however, such figures should be used cautiously. While DSAA tracks FMS, for which it is the lead agency, the main data on direct commercial sales deliveries are derived at secondhand from U.S. Customs figures made available to the State Department.

Although the FMS process is not difficult to grasp, its effects on the domestic arms industry are controversial.[24] There are some clear advantages from both the buyer's and seller's perspective. A Foreign Military Sale is a cradle-to-grave process managed by DSAA. The weapons package assembled by DoD guarantees "single vendor integrity"—the same parts over the life of the weapon system. Further, the purchaser pays only the actual cost to DoD, plus a 3-percent fee for DSAA, with profits controlled by the Federal Acquisition Regulations. And once U.S. equipment is deployed overseas, foreign governments have access to DoD stocks in times of emergency. Some foreign governments actually feel more comfortable with a process in which DoD handles all the paperwork. Finally, the DSAA field staff of DoD Security Assistance Officers, while not defense equipment sales representatives, do serve to promote U.S. arms transfers indirectly. For DSAA, the presumption is that the United States will sell a system to a foreign government if it can. Such indirect marketing assistance can be quite valuable to U.S. defense manufacturers.[25]

Direct commercial sales also have advantages. Company-to-company negotiations cut procurement lead times, enable the supplier to tailor the package to its customer's needs, and allow the customer to buy new equipment directly from the production line. For U.S. defense companies, the direct sale is the process of choice. One major exporter noted that there are three conditions that enable it to make a profit on international sales: 1) if it can sell commercially, 2) if, as with Israel, the foreign government does business with the U.S. supplier on a direct commercial basis and pays more than the U.S. Government would, or 3) if a foreign country buys spare parts directly from the supplier.

Through an intricate division of labor, DoD and the State Department make security assistance policy. Once the President certifies a country as eligible to buy U.S. weapons, State determines what major sales may be made. This determination involves extensive consultation with DSAA field staff on foreign countries' requirements, with the Defense Technology Security Agency, and with the Services. If agreement on the desirability of the transaction is reached, State then issues the munition export licenses required by the International Traffic in Arms Regulations. DoD determines what equipment is available for sale, administers the FMS program, and implements the funding of FMS and

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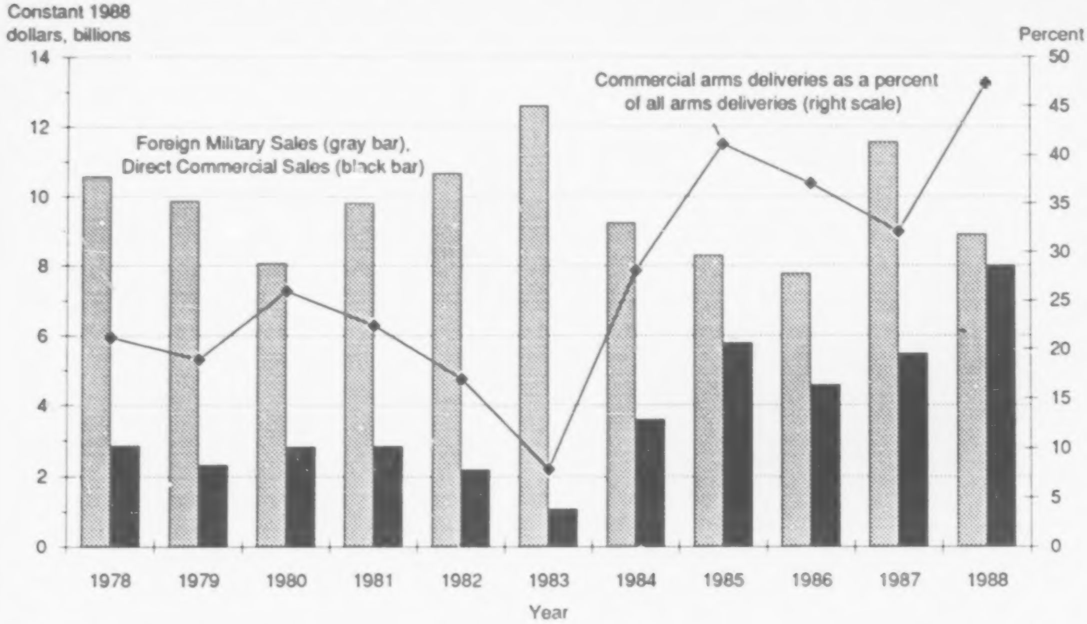
[23] For a brief description of how FMS and direct commercial sales work, see OTA, *Arming Our Allies*, op. cit., footnote 18, app. B, "Techniques and Mechanisms for Cooperation," pp. 96-101.

[24] On the advantages and disadvantages of FMS and direct commercial sales, see U.S. Department of Defense, Defense Security Assistance Agency (DSAA), "A Comparison of Direct Commercial Sales and Foreign Military Sales for the Acquisition of U.S. Defense Articles and Services," August 1989.

[25] U.S. security assistance efforts to promote U.S. defense equipment sales are minor compared to those of the United Kingdom and France, both of which have very active government defense sales organizations.

Figure 3-3—Foreign Military Sales v. Direct Commercial Arms Deliveries, 1978-88 (constant 1988 dollars, billions), and Commercial Arms Deliveries as a Percent of All Arms Deliveries



SOURCE: Office of Technology Assessment, from data in U.S. Department of Defense, Defense Security Assistance Agency, "Fiscal Year Series," Sept. 30, 1989, p. 2.

other military assistance programs. Ultimately, the decision whether or not a sale will be made depends on a variety of considerations: the sensitivity of the technology being exported, the sale's impact on regional security, its effect in limiting the adversary's influence, and the like.

For weapons exporters, the decision to sell through FMS or directly is not theirs to control.[26] Firms would be indifferent to which route buyers prefer were it not for some unattractive features of the FMS process. The most notorious of these is the 3-percent surcharge that DSAA levies on foreign military sales, which may be regarded as DSAA's management fee (covering 80 percent of its operating expenses). This fee depresses the value of the sale to the supplier because a firm is not permitted to charge more on foreign than on domestic sales. Further, DSAA has enabling legislation that waives recoupment of nonrecurring costs, such as for R&D. In other words, in a government-to-government sale, DoD recaptures the contractor's R&D investment and transfers it to a miscellaneous account in Treasury.

Many defense firms complain that the surcharge works against their interest in gaining international business because it makes FMS transactions less profitable than direct sales, and that financing DSAA's activities this way may provide DSAA with an incentive to direct sales through FMS rather than commercial channels.[27] However, DSAA argues that waiving recoupment of nonrecurring costs means that DoD effectively lowers the price of U.S. weaponry for our friends and allies, which can have a dramatic effect on marketing. Finally, the 3-

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[26] Even where sales are direct, DSAA can still intervene, especially where the sale involves transfer of technology developed under U.S. Government contract.

[27] Industry specifically opposes imposing nonrecurring recoupment surcharges on direct commercial sales and on nonmajor defense equipment for FMS. DSAA maintains that imposing surcharges on direct sales and not on FMS would undermine government neutrality toward the two major sales options, thereby skewing military sales toward DCS. See Carlos Aquino, *Strengthening the Army-Industry Dialogue on Defense Cooperation and Trade* #AR910R1 (Bethesda, MD: Logistics Management Institute, November 1990), p. 3-3.

percent surcharge may also have the effect of motivating DSAA to promote defense sales in general.

U.S. defense manufacturers claim further that the FMS system is inflexible because customers can seldom get pricing information in less than 90 days. Countries might also want flexible waivers and guarantees, which are almost impossible to get through DSAA.[28] Even where DSAA is willing to leave the choice of FMS or direct sale up to the customer, one of the Services might add a proviso to the export license requiring that it go FMS. Many sales that are nominally direct have as many as a dozen provisos attached requiring that some components or subsystems be sold government-to-government.

Defense firms also assert that an FMS makes it more difficult for them to negotiate offsets with the customer, since DoD will not pay for offsets as part of an FMS. Instead, they must be negotiated separately by the purchaser with the contractor. Most U.S. contractors view offsets as a necessary condition of doing business with certain countries. If the U.S. Government prohibited U.S. companies from offering offsets, it would effectively cede many markets to foreign suppliers. Moreover, contractors can do several things to dilute the impact of offsets on their profits, such as trading offset credits with other firms or overestimating the dollar value of the technology they are transferring. One contractor contacted by OTA put the matter this way: ‘‘An offset is an evaluation of what's valuable; in other words, we get the work done overseas because it's cheaper than doing it at home.’’[29]

There remains the question of whether FMS and direct sales can be regarded simply as economic transactions. Viewed purely as commercial agreements, either route may appear cost-effective depending on the buyer's degree of sophistication, the level of support he desires, and the price he is prepared to pay. Even with an FMS agreement, companies can still make more money on foreign than on domestic business because they are spreading their fixed overhead over a larger base—not to mention the importance of foreign contracts that keep production lines open long enough for domestic sales to resume.

But to view weapons exports in such terms is perhaps to miss the point. DSAA exists not so much to improve the U.S. trade balance as to further certain national security and foreign policy interests. One of these is to promote foreign procurement of U.S. defense equipment consistent with U.S. security objectives; another is to prevent the export of sensitive technology that might fall into the hands of current or potential adversaries. For this reason, the United States negotiates government-to-government Memoranda of Understanding when such technologies are included in weapons transfers. It was likewise for reasons of national security that, in negotiating the sale of F/A-18s to South Korea, DoD placed certain items on a government-to-government ‘‘must list’’ (i.e., made them subject to FMS) and prohibited directed buybacks. (Similar conditions are likely to be imposed on the newly proposed F-16 sale to South Korea.)

It is, however, legitimate to ask whether DSAA and DoD are the proper fora for balancing concerns about arms proliferation against the perceived need to strengthen the defense industrial base. Given its mission, DSAA is not likely to have an arm's-length relationship with its suppliers. After all, an FMS sale is a contract with a domestic supplier. And whatever problems firms have with the process, it represents a sale that might otherwise not be made. Moreover, FMS surcharges, which amount to approximately $330 million per year, fund Service military assistance programs and support DSAA operations.[30] There may be a conflict of interest inherent in a situation where an agency reaps a surplus from the industry it regulates.

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[28] Some FMS transactions include cross-leveling agreements, by which country funds on deposit in the FMS trust fund can be moved between separate FMS purchases or to and from special holding accounts. Where a direct commercial sale normally has a fixed price, a cross-leveling agreement gives the buyer greater flexibility in meeting changing requirements. See the Defense Security Assistance Agency (DSAA), ‘‘A Comparison of Direct Commercial Sales,’’ op. cit., footnote 24, p. 18.

[29] For data on offsets, see Executive Office of the President, Office of Management and Budget, *Offsets in Military Exports* (Washington, DC: Office of Management and Budget, December 1988).

[30] In this context, it should be noted that DSAA has experienced serious problems in administering DoD's FMS trust fund. DSAA's failure to develop a system to correct accounting deficiencies in the FMS program led DoD to transfer responsibility for the system from DSAA to the Air Force in July 1988. See U.S. General Accounting Office, *Financial Integrity Act: Inadequate Controls Result in Ineffective Federal Programs and Billions in Losses*, GAO/AFMD-90-10 (Gaithersburg, MD: November 1989), p. 33.

WHAT THE DEFENSE INDUSTRIES WANT

Industry complaints about Foreign Military Sales are only part of a broader critique of the export control regime that appears to have outlasted the Cold War that established it. The defense industry's position is that the government has a legitimate interest in protecting the defense industrial base by promoting arms exports. As expressed by the Defense Policy Advisory Committee on Trade (DPACT), an industry group that consults with the Secretary of Defense and the U.S. Trade Representative, "the wisest policy for government to pursue is to ensure that mechanisms are in place which will enable industry to keep ahead, both technically and economically, of the foreign competition."[31]

For all the obstacles U.S. firms face in selling overseas, they have one great advantage. With the Soviet threat now almost irrelevant, the United States has become, almost in spite of itself, the world's largest arms supplier and the one with the best products. For economic as well as strategic reasons, a case can be made—and is being made—that the government has much to gain by supporting U.S. arms exports.

DPACT's position is best considered in light of U.S. export controls. The State Department implements the Arms Export Control Act of 1976 through the International Traffic in Arms Regulations, which are based on the U.S. Munitions List maintained by DoD.[32] The Export Administration Act of 1979 (EAA), as amended, controls the export of dual-use technologies that could significantly augment the military capabilities of an adversary. The Commerce Department's Bureau of Export Administration administers the EAA.[33]

Of these agencies, the State Department has perhaps been the quickest to recognize that the environment within which export control policy is made has changed. In January 1990 the State Department replaced the Office of Munitions Control with a new Center for Defense Trade based in the Bureau of Politico-Military Affairs. Comprising an Office of Defense Trade Controls and an Office of Defense Trade Policy, the Center combines licensing and enforcement with the setting of policy for commercial defense trade.

Thus, the new Center serves two related purposes. First, as State Department officials made clear, the Department concluded that "complaints about the understaffing and underfunding of [the Office of Munitions Control] were entirely legitimate."[34] The number of licenses OMC handled had risen from 20,000 annually in the early 1970s to 60,000 a decade later, before falling back to 54,000 in 1990. On one level, then, the Center's purpose was one of administrative consolidation: to reduce backlogs and increase efficiency by bringing more resources to bear.

But the 1990 reorganization was also designed to reduce unnecessary impediments to defense trade. The State Department has endorsed the position that it should support U.S. defense trade, whether by more timely processing of export license applications or by enjoining personnel in U.S. missions to promote purchases of U.S.-made military equipment, as a July 1990 memorandum by Deputy Secretary Lawrence Eagleburger directed.

Yet the export control regime remains, in most respects, what it has been for the past two decades. It is complex, geared to political and military conditions that no longer exist, and open to the charge that it penalizes domestic suppliers without effectively controlling the worldwide dispersion of defense technology.

Even those who administer export controls find the process difficult to grasp; and as one regulator conceded, the EAA "is an antique, because it no longer addresses our concerns." The first National Academy of Sciences study of the current export control regime (also known as the Allen Report) noted the chilling effect that controls on the export of dual-use technology have on overseas sales. Most importantly, the report concluded that "the United States must clearly distinguish foreign policy export controls from national security export controls."[35]

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[31] Defense Policy Advisory Committee on Trade (DPACT), *Year-End Review*, op. cit., footnote 11, p. 4.

[32] The latest version of the ITAR is published in 22 CFR 120-130 (November 1989).

[33] In mid-November 1990 President Bush pocket-vetoed a bill amending the EAA that would have:

- created an essentially license-free Coordinating Committee for Multilateral Export Controls (CoCom), the principal forum for devising common export control among Western Alliance members. In effect, U.S. companies would not have needed licenses to export to CoCom countries;
- created a statutory licensing regime for missiles and chemical and biological weapons, and imposed sanctions against the United States and foreign countries for violating controls;
- given "good" East European countries unlimited access to telecommunications equipment; and
- tied the U.S. Munitions Control List to the CoCom Munitions List.

[34] U.S. Department of State, Bureau of Politico-Military Affairs, *Defense Trade News*, vol. 1, No. 1 (Washington, DC: Center for Defense Trade, March 1990), p. 5.

There is a deceptive similarity between the findings of the Allen Report and the policy positions of DPACT members. Both would like to see the export regime streamlined; both criticize the emphasis of regulations on East-West trade, at a time when the Soviet threat is greatly diminished; and both would like to see export controls focus on a carefully crafted "core list" of the most sensitive technologies.[36] And it is these views that prevailed in the late 1980s.

The similarities between the Allen Report and the views of DPACT members are superficial, however, because the latter propose the de facto deregulation of the U.S. arms industry while the Allen Report accepted the need for some control of weapons proliferation. Testifying before Congress, one DPACT member argued that "we can meet the competitors in the international marketplace if we're not hobbled by rules."[37]

But the industry that DPACT represents wants more than a relaxation of the more onerous controls. Commenting to OTA that Congress has waived certain FMS requirements for NATO allies and Japan, one executive remarked that it had not done the same for "those cash-strapped countries that may be the biggest customers." While paying lip service to government export controls, industry officials would like the U.S. Government to take a much more active role in helping them sell weaponry overseas.

What this means is that U.S. agencies would be far more involved in closing deals than they are now. To the extent that DPACT represents an industry consensus, that industry would like government assistance in four ways. After removing regulatory obstacles, industry representatives believe, the most important action the U.S. Government could take would be to promote the financing of defense exports. With certain exceptions, the Export-Import Bank is barred by law from financing military exports to developing countries, and as a matter of policy, it has refused to support sales to developed nations.[38] Available government financing, such as the FMS fund for security assistance, goes to developing countries that wish to arm themselves with U.S. equipment and is largely earmarked by Congress. There is no program to encourage private institutions to finance exports to countries with defense needs.

Second, industry representatives want DoD approval for in-country demonstrations of U.S. weaponry. Many countries will not buy weaponry without such demonstrations, which require DSAA approval. Even absent such approval, however, firms may find ways to demonstrate their wares. For instance, F-16s from the Netherlands and F/A-18s from Canada have been flown to the Farnborough (U.K.) Air Show for demonstrations, while U.S.-manufactured planes were on static display.

Third, the U.S. defense industry would like the assistance of the State and Defense Departments in making international sales. Several executives noted that the official in charge of foreign sales at the U.K. Ministry of Defense is one of the highest-paid executives in the British Government. They contend that given the size of the U.S. military budget, the U.S. Government could do worse than take an example from the British—with 40 to 60 attachés in Washington—and increase the number of security assistance officers at many embassies.

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[35] National Academy of Sciences, *Balancing the National Interest: U.S. National Security Export Controls and Global Economic Competition* (Washington, DC: National Academy Press, 1987), p. 19. The report adds that "to the extent that the United States fails to distinguish clearly between the two, allied cooperation in support of consensual national security objectives is undermined." Lew Allen, former Air Force Chief of Staff and current Director of the Jet Propulsion Laboratory, chaired the panel that drafted the report.

[36] The Allen Report focuses on the export of dual use goods and technology, not military hardware. It does, however, note that the Arms Export Control Act "appears to function well." Ibid., p. 37.

[37] Lt. Gen. Howard M. Fish (USAF Ret.) statement in hearings before the House Committee on Banking, Finance, and Urban Affairs, in U.S. Congress, Subcommittee on Economic Stabilization, "Internationalization of the Aerospace Industry," 101st Congress, 1st sess. (May 10, 1989), p. 41. At the time, Gen. Fish was chairman of the American League for Exports and Security Assistance.

[38] Stuart Auerbach, "Defense Firms Seek Ex-Im Bank Aid in Selling Their Equipment Overseas," *The Washington Post*, Jan. 10, 1991, p. D1. At this writing, the Bush Administration has sent legislation to Congress that would enable Ex-Im Bank financing for military sales.

Finally, the industry would prefer more direct commercial sales instead of FMS. Government-to-government memoranda of understanding (MOUs) make sense where sensitive military technologies are involved. But some industry sources claim that MOUs are often negotiated where coproduction or codevelopment are not involved. By permitting more direct sales, the U.S. Government would give domestic firms a competitive advantage over European suppliers.

Chapter 4

European Defense Industries: Politics, Structure, and Markets

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Chapter 4

European Defense Industries: Politics, Structure, and Markets

The European defense industries, and the role they play in the global defense market, are currently undergoing rapid mutation. Political and economic changes in Europe and the Soviet Union, while reducing tensions that have made defense cooperation necessary, have also made it increasingly difficult for NATO to function as a U.S.-European defense industrial coordinating structure. Europe may be headed toward a consolidated security and defense pole independent of the United States, despite setbacks to European integration caused by the Persian Gulf War.

European economic integration has forced significant changes in the structure and activities of European defense firms. At the same time, defense production overcapacity, falling defense budgets associated with the end of the Cold War, and shrinking defense export markets have caused a deep recession in the defense industries worldwide. These factors have catalyzed profound structural reorganization of the European defense industries. Finally, the Iraqi invasion and occupation of Kuwait and the response of the U.S.-led coalition has presented the world with much more complex security and defense industrial problems than imagined in the days following the fall of the Berlin Wall.

European firms are increasingly competitive with the United States in a wide range of defense technologies, both in terms of price and quality, and they face strong pressure to export these systems. But more important, worldwide distribution of European weapons poses considerable security problems for the United States, as demonstrated in the Persian Gulf War. In the future, U.S. defense planners will have to pay greater attention to defense against weapons produced by our allies, but used by third parties.

Changes in the European defense industries are, therefore, of considerable importance to the study of the global defense business and the challenges it presents the United States. This chapter focuses first on the security context of European armaments production, and then turns to the economic and structural changes that affect European defense firms and how they do business.

ADJUSTMENTS TO NEW STRATEGIC AND ECONOMIC REALITIES

The decline of Soviet power in Central Europe, the unification of Germany, and the Persian Gulf War are events that could scarcely have been anticipated a short while ago. The hitherto orderly preparations for the economic integration of Western Europe into a single integrated market at the end of 1992 have been thrown into disarray by recent events. The outbreak of war with Iraq has increased concern about Germany's place in Europe, raised a new dimension of the perennial "burden sharing" issue, called into question European arms export practices, and exposed deep tensions among NATO members. A new Europe is in the process of creation, but what its ultimate form and substance will be remain clouded in the rush of events.

It appears beyond question, however, that the Warsaw Pact cannot be reconstituted as a serious menace to the security of Western Europe.[1] Thus the Soviet threat to NATO's central front, which has dominated U.S. and European strategic thinking since the end of World War II, has been virtually eliminated in the course of 1 year. This implies a series of political and economic consequences that directly affect the environment in which the European armaments industries operate.

The Conventional Forces in Europe (CFE) negotiations are scheduled to continue, and circumstances are such that both the United States and the Soviet Union may be constrained to draw down from the central front both in larger numbers and earlier than limits set by negotiation. The spreading economic and social disorganization within the Soviet Union, and the demise of Soviet-controlled regimes in Eastern Europe make it doubtful that the Soviets will be able to maintain large numbers of effective forces in Central Europe. Over 100,000 U.S. troops in the

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[1] On Apr. 1, 1991, the Warsaw Pact was formally dissolved.

NATO area have been transferred to the Persian Gulf, and are unlikely to return in view of the reduced Soviet threat and domestic budgetary pressures. This is likely to remain true despite the fact that U.S.-Soviet negotiations under CFE have recently been clouded by unilateral Soviet changes in previously agreed troop counting arrangements combined with a souring of bilateral relations following Soviet repression of independence movements in the Baltic republics.

Western European public support for military spending, which at least by U.S. standards has never been strong, has been low throughout most of the last decade. The current shift in the balance of power in Central Europe will put further downward pressure on Western European military budgets, as attention shifts to the social and economic challenges of European integration and dealing with the ravaged economies of Eastern Europe. By one estimate, total European defense spending will fall from $147.4 billion in 1990 to $145.1 billion in 1995, without considering the effect of inflation;[2] assuming a 5-percent rate of inflation, this comes to about $112 billion in 1990 dollars, a 23-percent reduction.

The effect of the war with Iraq on European defense spending will probably be small, given the modest European military contribution to the coalition. Furthermore, as U.S. force allocations for NATO decline under budget pressures and the need for redeployments to meet military contingencies in Iraq and elsewhere, the "burden sharing" argument for maintaining Western European military budgets at current levels loses much force.

Germany has proposed to reduce its forces from 445,000 to 370,000 troops (including East German forces) and is set to pay the Soviets about $7 billion for housing and other costs associated with the repatriation of Soviet forces now stationed in the former Democratic Republic. Furthermore, lack of a credible Soviet threat has eroded some support for continued involvement in the European Fighter Aircraft (EFA) consortium beyond the R&D phase, a project that had as its military justification a requirement to counter sophisticated Soviet MiG-29 fighters. In addition to costs of reunification, Germany will be thrust into the lead in regional economic rehabilitation of Eastern Europe, both to protect its extensive commercial investments and to forestall waves of immigration that would inevitably accompany economic disintegration within the region. All this will put the German budget under great strain, and the defense sector is a likely source for much of the required funds. The 1991 defense budget presented to the Bundestag reflects a 15-percent decrease from the combined Federal and former Democratic Republics.[3]

Photo credit: General Dynamics Corp.

The NATO Stinger man-portable antiaircraft missile program, for which Dornier and Diehl are the main contractors, is supplying weapons for Germany, Belgium, Greece, Italy, the Netherlands, and Turkey. Switzerland is also producing the Stinger. General Dynamics began development of the system in the early 1970s, and it was first deployed in West Germany in 1981.

The French are also set for a lowering of defense expenditures in the light of a diminished Soviet threat perception. The French "Armees 2000" force rationalization plan proposed by former Defense Minister Jean-Pierre Chevenement to respond to lessening tensions calls for "a lessened rate of rise in defense appropriations, and a continued decline in troop strength." Defense spending in 1990 declined

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[2] Giovanni de Briganti and Theresa Hitchens, "War Further Pinches European Defense Firms," *Defense News*, vol. 6, No. 6, Feb. 18, 1991, p. 15.

[3] "Germans Trim Budget," *Defense News*, vol. 6, No. 8, Feb. 25, 1991, p. 2.

Box 4-A—Security Arrangements in Europe

Large uncertainties about the future of NATO, in particular the political will and economic ability of the United States to continue spending hundreds of billions of dollars for European defense in the face of a rapidly receding Soviet threat, and the as yet undefined role of a reunited Germany within Europe, have given rise to much speculation about the need for new European security arrangements. Although the security interests of each European state differs in detail, the tasks facing European defense planners generally are:

- assuring that Germany—now the strongest state on the continent—will be closely bound politically and economically to the rest of Western Europe;
- containing the threat posed by highly armed and unstable Islamic regimes spread across the North African littoral, through the Persian Gulf, and beyond;
- bringing the newly democratic states in Eastern Europe and the Soviet Union into a more normal economic and security relationship with Western Europe.

There is as yet little agreement among the major European powers as to the priorities of these tasks and the international modalities best suited to accomplish them.

France, which appears to be most worried about the emergence of a strong and independent Germany, wishes to speed along both the economic and monetary unification of Western Europe, and involve Germany in a defense relationship centered perhaps on the European Community (EC) or a drastically modified NATO essentially under European control. In line with this policy, France has been one of the chief catalysts for sponsoring intra-European industrial and arms cooperation through the Independent European Producers Group (IEPG) and through technical cooperative programs such as BRITE, JESSI, EUCLID, etc.

For its part, Germany perceives advantage in moving quickly on economic union under the EC but at the same time has strong commercial and strategic interests in Eastern Europe and the Soviet Union. It thus appears to many Germans that activating and strengthening some European forum more inclusive than the EC, such as the now largely dormant Conference on Security and Cooperation in Europe or the Western European Union should receive high priority as well. The United Kingdom is the most reluctant of the major European powers to cede political and defense autonomy to a centralized European authority, although its fragile economy is now so dependent on the cooperation and prosperity of partners on the continent that it can only delay, but probably not decisively alter, the establishment of a new European security framework.

5 percent in real terms from 1989 levels, and perhaps 15 percent more in 1991. In fact, some members of the French parliament are now concerned that force reductions already have gone too far and that combat readiness is threatened.[4] French troops committed to Germany will decline from 50,000 to 35,000 over the next year. However, the full measure of French feeling will not be revealed until the next defense program law debate in Parliament in October, 1991.

The British military likewise plans significant reductions in defense expenditures and troop levels. In June 1990 orders were canceled for an additional 33 Tornado aircraft and after a major defense review in August 1990 the reduction of the British Army of the Rhine to 50,000 troops in 1991 was announced. Defense budgets are set to decline in real terms, and will fall from 4 percent of gross domestic product in 1990-91 to 3.4 percent in 1993-94.[5] Defense procurement has already undergone significant trimming under Sir Peter Levene, who has cut subsidies to defense contractors, stiffened competition, and promoted defense industry consolidation. His claim is that henceforth the procurement executive is to be guided by the principle of "value for money," although significant purchases of non-British equipment (apart from U.S. AWACS) have not yet materialized. Officials at the U.K. Ministry of Defense claim that procurement practice changes are now resulting in cost savings of about 30 percent.

The future mission and structure of NATO in post-Cold War Europe is currently under review. The general sentiment on both sides of the Atlantic is that a continued U.S. military presence in Europe would lend "stability" in a time of unprecedented change, but it is by no means certain that NATO could be restructured to meet this new, if somewhat nebulous, mission.[6] Two main issues will require resolution. First, while Germany has pledged itself to continue membership in NATO, it remains unclear whether the present or succeeding German governments can withstand popular demands that Germany should be cleared of nuclear weapons. This, in the view of even some strongly Atlanticist strategists, could be the final blow for NATO, at least as presently constituted.

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[4] Jacques Isnard, "French 'Armees 2000' Plan: A Difficult Balancing Act," *Aviation Week & Space Technology*, vol. 133, No. 10, Sept. 3, 1990, p. 65.

[5] "U.K. Defense Spending To Decline Despite Gulf War," *Aviation Week & Space Technology*, vol. 134, No. 6, Feb. 11, 1991, p. 26.

The second and possibly more important issue concerns new goals for NATO. The United States proposed last year that NATO discuss both its reorientation to more political or social ends and coordination of its military activities with such out-of-area states as Japan. These have not met with much resonance by the Western Europeans, who in the 40-odd year history of the Alliance have resisted U.S. attempts to widen NATO's sphere of interest beyond Europe proper.[7]

While the debate between the "wideners" and "deepeners" of the various proposed loci for European security cooperation continues, the Persian Gulf War aroused the attention of Europe, and in particular France and Italy, to the threat posed by Arab nationalist and fundamentalist states armed with advanced imported weapons (see box 4-A). The uncoordinated and tentative collective response of the Western Europeans to the Persian Gulf events has pointed up the political and administrative difficulties the Europeans have in consulting on defense affairs outside Europe.

Perhaps of even greater importance is that the most dangerous weapons in the Iraqi arsenal confronting Western forces in the area—improvements in the Scud missile to strategic ranges; thousands of Milan, HOT and Exocet missiles; top-of-the-line Mirage fighters; and sophisticated production facilities for chemical weapons—were predominantly of European provenance. Since the invasion of Kuwait, public attention to events in the Persian Gulf have been the source of an unceasing stream of revelations highly embarrassing to European governments, past and present (see box 4-B).

EUROPEAN DEFENSE INDUSTRIES IN A CLIMATE OF UNCERTAINTY

Unlike the defense markets of the United States or the Soviet Union, European defense markets are individually too small to support purely domestic defense industries.[8] This has led to three main developments.

First, European defense firms are required to export substantial quantities of defense equipment in order to gain the production efficiencies and cost reductions that lead to affordable armaments and research and development. This strategy was successful in a time of expanding markets, as during the mid-1970s to early 1980s, but with declining demand, the extensive production capacity built up over this period can no longer be supported.

Second, the search for ways to extend production runs and fund increasingly expensive research leads to international collaboration, particularly with close political allies. In the past, the United States was the principal partner for European defense industries, but due, in part, to U.S. restrictions on the export of U.S.-originated technology, Europeans have turned to each other and to developing nations as collaboration partners (see figures 4-1 and 4-2). In general, the Europeans do not buy as much from the United States as in the past.

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[6] NATO is reportedly considering a change from a forward deployment strategy to a "forward presence" strategy, in which a small number of highly trained and mobile troops in either national or multinational units will be able to respond to crises. The new strategy counts on air transport to quickly shift troops and tanks into defensive positions while reserve forces are mobilized. This may be combined with national specialization on some tasks, which would reduce costs and provide political benefits for countries that find it difficult to commit front-line troops in a crisis. Michael Mecham, "Reduced Threat, Budgets Driving NATO to New Strategy as Europe Tries To Unify," *Aviation Week & Space Technology*, vol. 134, No. 11, Mar. 18, 1991, pp. 66-67.

[7] As for nonmilitary NATO activities, the U.S.-inspired Committee for the Challenges of Modern Society (NATO CCMS), which sponsors projects ranging from health care to environmental protection, remains rather a side-show, and is sometimes criticized for infringing on matters best left to nonmilitary international organizations, such as the Organization for Economic Cooperation and Development (OECD).

[8] For example, fighter and attack aircraft production becomes profitable only after over 600 planes have been built, due to the time required to learn to build them (learning curve) and the associated economies of scale. At the same time, European countries, even the largest, have requirements for much smaller quantities. For example, in the European Tornado attack airplane consortium, the United Kingdom maintains in its current arsenal only 310, Germany 326, and Italy 97 airplanes. Similar numbers obtain for other collaborative aircraft projects, such as the European Fighter Aircraft (EFA). In the same vein, the French Air Force has only 246 of approximately 670 Mirage F-1s produced through 1986, while the rest were exported to at least 10 foreign countries.

Box 4-B—European Arms Sales to Iraq

Revelations of the nature and extent of German industrial involvement in developing Iraqi capability to produce weapons of mass destruction have provoked wide public comment. Over 80 German firms, including such respected enterprises as MBB and Karl Zeiss, have been implicated as suppliers for Iraqi unconventional weapons capability. The Karl Kolb firm has been identified as the principal contractor for the Iraqi nerve gas plant at Samara, perhaps the largest in the world. Beyond the exposure of extreme German laxity in the enforcement of its export controls, evidence has emerged that governmental assistance was provided for some of the most dangerous technology exports to Iraq, such as the compressors used to improve the range of the Scud missile.[1]

With $3 billion in sales for such items as Mirage fighters and Exocet missiles, the French have been the most prominent western supplier of complete weapons systems to Iraq. The Iraqi invasion of Kuwait provoked something of a crisis in the French Government, eventually leading to the dismissal of Defense Minister Jean-Pierre Chevenement, a founding member of a French-Iraqi friendship society. Before leaving government, Chevenement provided an interesting historical sidelight on the sale of the Osirak reactor to Iraq, which the French had steadfastly declared to be solely capable of nuclear research. Referring to the former prime minister at the time of the sale, Chevenement declared: ''Let Mr. Chirac be asked about the circumstances in which he authorized a certain number of big contracts, including the nuclear one in 1975.''[2]

Besides France and Germany, other European countries shown to have made significant weapons or strategic technology sales to Iraq include Italy, Spain, Greece, and Austria. Thus far, only Austria—which sold 200 artillery pieces to Iraq that may well be superior to any in the coalition arsenal—appears to have launched a full-fledged investigation of possible misconduct by top government and industry officials.[3] The leadership of other European governments have been less forthcoming on the issue to date. While the Kohl administration has offered Israel $300 million, presumably in reparation for damages caused by Scud attacks, it has been essentially silent on the government's role in arming Iraq.[4] French President Mitterrand seems to have attempted to convert previous arms sales to Iraq into an asset, noting that these ''add moral weight'' to France's entry into the coalition. The ambiguous French position in the coalition has been highlighted by such incidents as its support of Iranian cease-fire initiatives, limitation of French air strikes to Kuwait, and delays in providing the United States with information on French arms sales to Iraq. In contrast, President Gorbachev has issued a frank apology for the Soviet arms supply to Iraq, which in retrospect appears to have been considerably more discriminating than the Europeans concerning strategic and nonconventional weapons.

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[1] The West German firm Havert received $1 million in Hermes export guarantees for the compressors. See Marc Fisher, ''Germany Pledges $5.5 Billion More Toward Gulf War,'' *The Washington Post*, Jan. 30, 1991, p. A23. West German officials claim that Hermes is a self-financed, private insurance operation. However, as with Export-Import Bank guarantees, the insurer of last resort is the government.

[2] Cited in ''French Minister's Stand On War Draws Criticism,'' *The Washington Post*, Jan. 24, 1991, p. A30. France and the United States, among others, voted for the U.N. resolution condemning Israel for destroying the reactor in 1981.

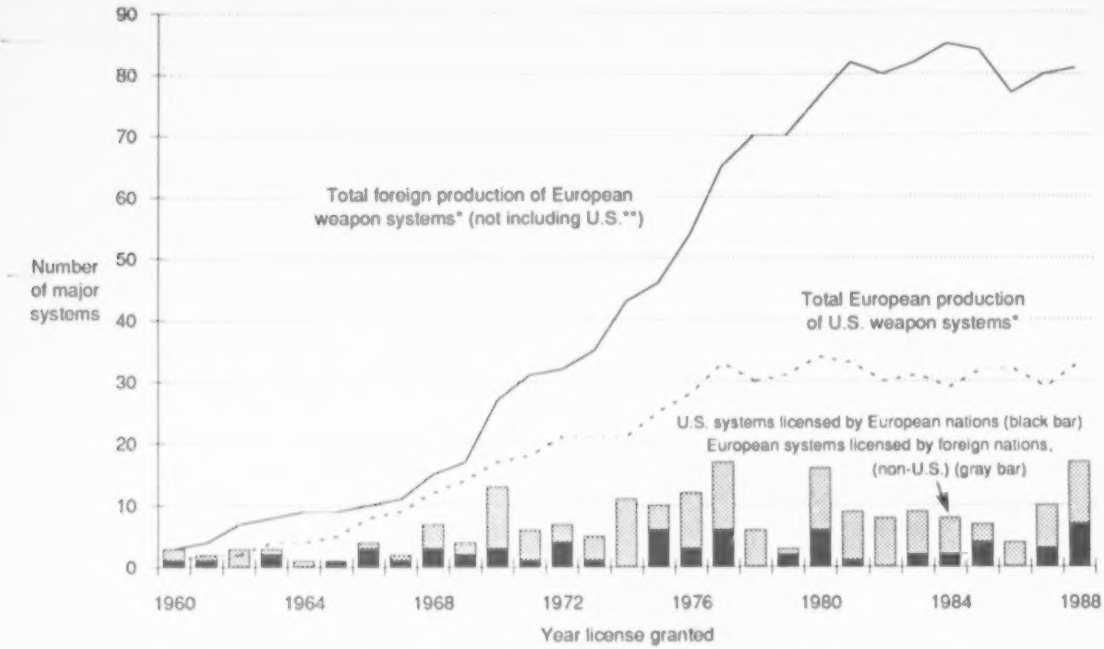
[3] The Austrians already had under investigation illegal sales of the same artillery to Iran, produced by the state-owned Voest company. Officials indicted include former chancellor Fred Sinowatz. See ''Austrians Convicted of Arms Sales to Iran,'' *The Washington Post*, Feb. 2, 1991, p. A14.

[4] Note, for example, statements of top Kohl intelligence adviser Bauenschlager and former Economics Minister Lambsdorff, ''Frontline'' broadcast, Public Broadcasting Service, Feb. 7, 1991. Both underscore that the German Government acted correctly in granting export licenses for dual-use technology, despite persistent news reports and official U.S. and Israeli warnings that these exports were destined for the Iraqi war machine.

However, despite the requirement for collaboration to make defense equipment affordable, European nations wish to maintain as much as possible their own defense industries, both to assure themselves access to defense technology for national security and for domestic industrial and trade reasons. The solution, developed over several decades, is that countries permit their defense firms to collaborate on specific projects and work out details of workshares and production to a highly refined degree.

Finally, in the major European defense industrial countries, France, Great Britain, Germany, and Italy, overcapacity so far has not caused defense firms to engage in extensive transnational mergers or acquisitions. Industry consolidation and reorganization has taken place for the most part within countries, and has resulted in the creation of de facto defense

Figure 4-1—Estimated Licensed Production of Major Conventional Weapon Systems in and from Europe, 1960-88



* Estimates based on the assumption that an average system is produced under license for 12 years.
** U.S. production of European systems is negligable: only 7 systems produced from 1965 to 1987.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

industrial monopolies.[9] Defense companies in the other European countries have taken subcontracting roles or have been acquired by defense firms in the major defense industrial countries, such as France's GIAT Industries purchase of Fabrique Nationale, the Belgian gun manufacturer.

European defense suppliers currently operate in an atmosphere in which very little can be confidently predicted. Their production and research structures, domestic and export markets, profits and employment are intimately connected to the decisions of governments groping to adjust to the new political and economic realities. The European defense market, already small by U.S. standards, appears destined to shrink still further, and R&D investments necessary to field competitive new weapons systems will become ever more costly.

Consequently, military procurements, at least on the weapons system level, both in the United States and NATO Europe are tending increasingly towards domestic suppliers (see table 4-1). The Europeans have long believed that the U.S. direct procurement market is essentially closed, and the only way it can be penetrated is at the industrial level by means of joint ventures or acquisition of U.S. defense firms (see table 1-1 in ch. 1). The major European supplier nations have achieved high levels of autonomy in arms procurements by domestic production and intra-European teaming. Furthermore, it appears that the principal defense industrial countries of Europe have targeted the smaller defense producing countries, such as the original F-16 countries (Denmark, Belgium, the Netherlands, and Norway)—the only remaining U.S. market in Europe for complete systems. The sales of U.S. components may also be affected, as suggested by the proposed European Commission directive for a tariff on defense components.

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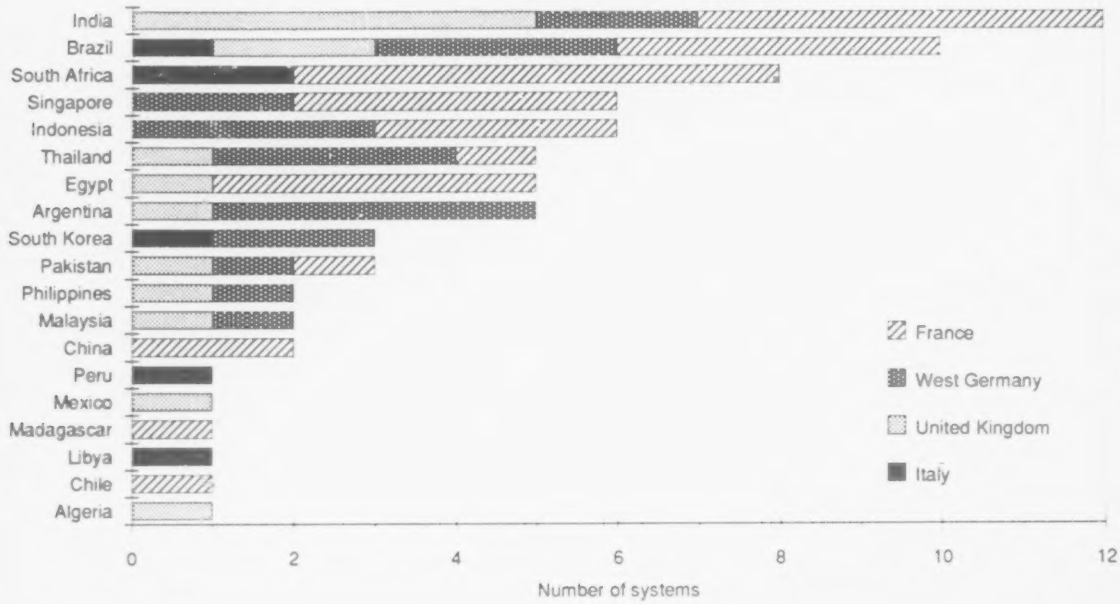
[9] Andrew Moravcsik, "The European Armaments Industry at the Crossroads," *Survival*, vol. 32, No. 1, January/February 1990, p. 69.

Figure 4-2—Licensed Production of European Major Conventional Weapon Systems by Developing Countries, 1960-88



SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Complicating the problems for the European arms manufacturers is that exports, on which the Europeans rely to a much greater extent than U.S. producers, have become much more difficult (see figure 4-3). Saturation, developing nations' debt, lower OPEC revenues, and competition from newly industrialized countries have combined to lower European export performance. European arms exports reached a 10-year low in 1989.

In addition, the Europeans perceive additional threats to their traditional export markets from the Soviets and the Eastern Europeans, who desperately need hard currency and who have large surplus weapons stocks and weapons production overcapacity. Beyond these factors, European arms suppliers believe that U.S. producers will compete fiercely for shrinking markets. The war with Iraq, however, may provide fresh opportunities for increased sales to the Middle East, absent agreement among major arms suppliers on sales to the region.[10] Efforts to promote such arms control agreements are at very early stages, but several countries, such as Germany, have tightened their national export control systems. It remains to be seen whether more comprehensive agreements will be forged.

REORGANIZATION FOR SURVIVAL: NATIONAL CHAMPIONS AND MULTINATIONAL CONSORTIA

Increasing reliance on domestic suppliers has created substantial overcapacity in defense industrial production. The question that faces European governments and industry is how to organize, on a national and multilateral basis, so that arms suppliers are provided some cushion against severe market uncertainties and to insure that Europe retains a competitive defense industrial base. The spate of mergers, take-overs, stock-swaps, teaming arrange-

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[10] The decisions of European governments participating in the coalition against Iraq may be seen at least partially motivated to protect current arms markets or create new ones. The United Kingdom's early and staunch lineup in the coalition parallels its interests in Saudi Arabia as the prime customer for British arms exports. The initial French refusal to bomb strategic targets in Iraq may have been prompted by hopes to retain its privileged position as weapons exporter to post-war Iraq, and its more recent tilt towards Iran may reflect interest in cultivating further potential arms buyers.

Table 4-1—Major Weapons Procurement Sources in the Major European Defense Industrial Nations, 1985-89 (percent)

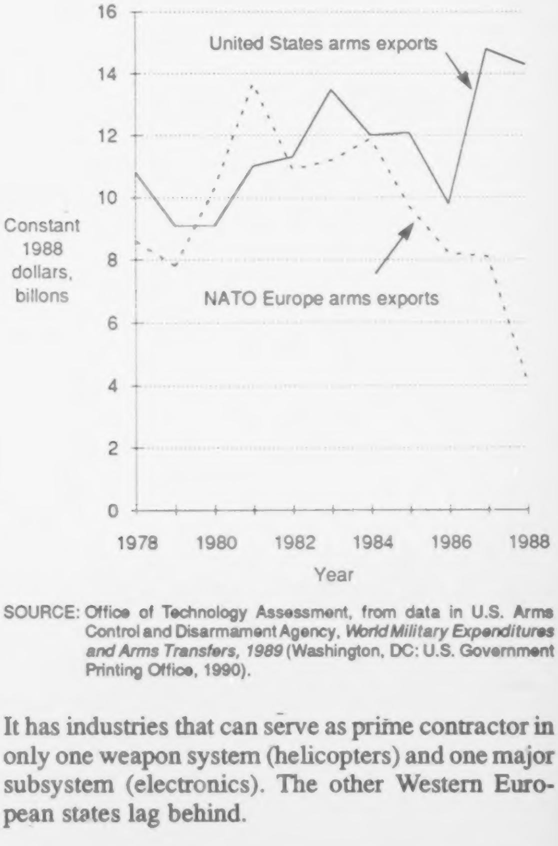
Country	Domestic	Codevelopment	Coproduction	Imports
France	80%	15%	0%	5%
United Kingdom	75	15	0	10
West Germany	45	25	20	10

SOURCE: Andrew Moravcsik, "The European Armaments Industry at the Crossroads," *Survival*, vol. 32, No. 1, January/February 1990, p. 66.

Photo credit: General Dynamics Corp.

Since the mid-1970s, General Dynamics' F-16 Fighting Falcon has been produced in Belgium, the Netherlands, Denmark, Norway, and Turkey, the so-called "F-16 countries."

Figure 4-3—NATO Europe and U.S. Arms Exports, 1978-88



SOURCE: Office of Technology Assessment, from data in U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

ments and other forms of alliance that has swept the European defense industries in the past several years has been in response to the overcapacity problem. While the process might appear superficially somewhat chaotic, the overall trends have been carefully guided by governments in the major arms producing states, and reflect their long-standing economic and defense priorities (see box 4-C).

The major suppliers—France, Germany, and the United Kingdom—are the only nations in Europe that possess the industrial, research, and financial capacity needed to produce a broad array of complete weapons systems. The policies of these countries dominate the overall arms productions situation in Europe and will determine its future size and shape. Italy stands in a somewhat half-way position. It has industries that can serve as prime contractor in only one weapon system (helicopters) and one major subsystem (electronics). The other Western European states lag behind.

The mergers that have occurred tend to consolidate at the national level those portions of the arms industry that governments perceive as both essential to their survival as major weapons producers and integral to their overall economic development plans. These industries are aerospace, missiles, and defense electronics, and are closely associated with the "sunrise" civilian industries (i.e., civil aircraft and engines, space satellites, telecommunications, computers, and electronics) that also have been fostered by governments. The defense and associated civil sector industries are usually merged in a

Box 4-C—European Defense Industrial Restructuring

Strategy	Examples
Internal reorganization	Fiat (Italy) subsidiaries Gilardini and SNIA-BPG, which each had some defense work, restructured to put all Fiat's defense activities in one entity.
Refocusing on main business	Philips (Netherlands) has sold off its defense subsidiaries, thereby leaving defense.
Cross-equity participation	General Electric Co. (U.K.), Daimler-Benz (Germany), and Wallenberg (Sweden) have each separately exchanged a small percentage of shares with Matra (France), in order to promote both high-level consultation on collaborative ventures and some technology sharing.
Taking over to diversify	Daimler-Benz (Germany) takeover of Dornier, MTU, AEG, and MBB (all Germany), and their consolidation into Deutsche Aerospace (DASA), British Aerospace (U.K.) acquisition of Rover, Royal Ordnance, Ballast Nedham, Arlington Securities (all U.K.), and numerous other British firms.
Creation of new company	British Aerospace and Thomson-CSF (France) may merge their guided missile businesses in Eurodynamics. Thomson-CSF general avionics business combined with Crouzet, Sfena, and Electronique Aérospatiale (all France) into new company called Sextant.
Strategic alliances	British Aerospace (BAe) and General Dynamics (GD) (U.S.) have made long-term commitments, including BAe's recent failed effort to sell GD's M1A2 tanks to the British military. United Technologies Corp. (UTC) (U.S.) and Daimler-Benz have formed a strategic alliance, one aspect of which is a new jet engine to be developed by UTC's Pratt & Whitney and Daimler's MTU.
Internationalization	Eurocopter (Aérospatiale and DASA); Eurodynamics (Thomson and British Aerospace merger of their respective missile businesses).
Multinational consortia	Panavia produces the Tornado attack jet (U.K., West Germany, Italy). Eurofighter is developing the European Fighter Aircraft (U.K., West Germany, Italy, Spain).

large conglomerate or "national champion," although mergers with unrelated industries take place as well. Such organizations generally hold the monopoly on national defense business in their sectors.

The process of consolidation is typified by recent mergers in the German aerospace industry. Messerschmitt-Bölkow-Blohm (MBB), itself a product of previous mergers, was united with Dornier to form Deutsche Aerospace, which was then united with the auto giant Daimler-Benz. The new conglomerate now covers all of the German civil and defense effort in space, aircraft, and missiles[11] (see figure 4-4). The equivalent U.K. national champion is British Aerospace, which is also associated with an auto producer, Rover, and which recently acquired the armaments producer Royal Ordnance. France still has two defense aircraft producers, Aérospatiale and Dassault, an independent missile producer, Matra and a major defense electronics firm, Thompson-CSF. Many observers expect that Dassault, currently short of orders and under serious financial pressure, will soon be folded into Aérospatiale, the state-held aerospace firm (see table 4-2).

The rush towards national defense industrial consolidation was provoked by the realization that

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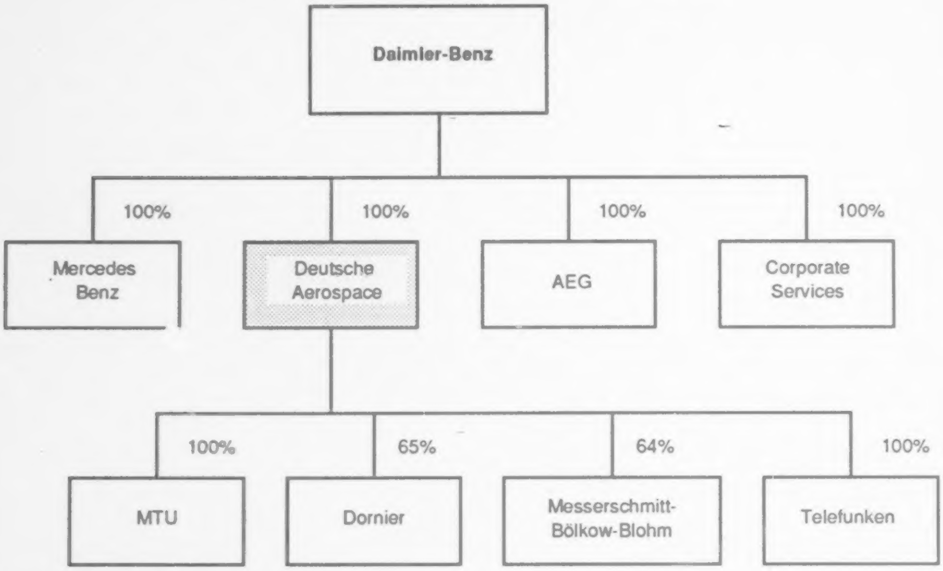
[11] The creation of Deutsche Aerospace was declared illegal by West German courts on antimonopoly grounds, but this ruling was subsequently overturned by the Economics Ministry. At the same time, the government ordered MBB to divest itself of its small naval defense activities, a move widely considered a sop to public opinion. Several German observers have noted to OTA privately that the government was particularly anxious to consummate the merger with Daimler-Benz to remove from the federal budget the subsidies paid to MBB for its participation in the Airbus consortium.

Figure 4-4—Daimler Benz Organization Chart, 1990



Percentages indicate portion owned by Daimler-Benz

SOURCE: Messerschmitt-Bölkow-Blohm.

Table 4-2—Principal European Defense Firms, 1990

Country	Aircraft	Tanks	Missiles	Electronics
France	Dassault Aérospatiale	GIAT	Matra Aérospatiale	Thomson-CSF
United Kingdom	British Aerospace	Vickers	British Aerospace	General Electric (U.K.)
Federal Republic of Germany	Daimler Benz/MBB	Krauss-Maffei	Daimler Benz/MBB	Siemens

SOURCE: Office of Technology Assessment, 1991.

for the foreseeable future, the European domestic market was too small to permit all-out competition among prime contractors at either the national or European level. Intra-European teaming among national champions thus became the safest and preferred route to produce new major weapons systems. To be considered a national champion at least two conditions must be met:

1. the organization must possess sufficient technological and financial depth to attract partners, and
2. must be able to offer these partners markets not otherwise available to them.

National champions meet these conditions by combining the relevant R&D resources, adding financial stability through association with a large civilian sector industry, and providing entree to its domestic defense market, and possibly foreign markets as well.

These national champions become the participants in European-based defense consortia such as Panavia, Eurofighter, Euromissile, Eurocopter, etc. (see table 4-3). In a typical project, workshares for each country are apportioned according to how much of the final product each country intends to purchase. For example, in the Panavia consortium, which produces Tornado attack airplanes, the United Kingdom has 48 percent, Germany has 40 percent and Italy has 12 percent of the workshares, with each country obligated to purchase an equivalent percentage of a 900 aircraft production run. EFA is similarly

Table 4-3—Selected European Defense Industrial Consortia and Joint Ventures

Consortium/Weapon System Project description	Firms (percent control)	Countries
Alpha Jet	Dassault (50)	France
	Dornier (50)	West Germany
EHI	Agusta (50)	Italy
Antisubmarine warfare helicopter	Westland (50)	United Kingdom
Eurocopter	MBB (50)	West Germany
Antitank helicopter	Aérospatiale (50)	France
Eurofighter	MBB (33)	West Germany
Tactical fighter	British Aerospace (33)	United Kingdom
	Aeritalia (21)	Italy
	CASA (13)	Spain
Euroflag	Aérospatiale	France
Tactical transport study	British Aersopace	United Kingdom
	MBB	West Germany
	Aeritalia	Italy
	CASA	Spain
JEH	Agusta (38)	Italy
Multirole light attack helicopter study	Westland (38)	United Kingdom
	Fokker (19)	Netherlands
	CASA (5)	Spain
NH 90	Aérospatiale (35)	France
NATO frigate helicopter	MBB (35)	West Germany
	Agusta (25)	Italy
	Fokker (5)	Netherlands
Panavia	British Aerospace (48)	United Kingdom
Tornado attack aircraft	MBB (40)	West Germany
	Aeritalia (12)	Italy
Sepecat	British Aerospace	United Kingdom
Jaguar strike aircraft	Dassault	France
Euromissile	Aérospatiale	France
HOT antitank missile	MBB	West Germany
Milan antitank missile		
ANS antiship missile		
Roland mobile antiaircraft weapon system		
Air-launched antiship missile		
OTOMAT antiship missile	OTO Melara	Italy
	Matra	France
Dragon	Thomson-CSF	France
Twin gun antiaircraft gun system	Thyssen	West Germany
Seaguard	Contraves	Switzerland
Close In Weapon System	Oerlikon	Switzerland
	Plessey	United Kingdom
	British Manufacturing & Research	United Kingdom
Martel	British Aerospace	United Kingdom
Air-to-surface missile	Matra	France
Apache	MBB	West Germany
Container weapon system	Matra	France
Mobidic	Aérospatiale	France
Modular stand-off weapon	Dornier	West Germany
	Thomson-Brandt	France
	Diehl	West Germany
Short Range Stand-Off Missile (SRSOM)	Dornier	West Germany
	Aérospatiale	France
	Thomson-Brandt	France
	Diehl	West Germany
AN/USD-502	Canadair	Canada
Reconnaissance drone	Dornier	West Germany
	SAT	France
Brevel	MBB	West Germany
	Matra	France
Advanced Short Range Air-to-Air Missile (ASRAAM)	British Aerospace	United Kingdom
	Bodenseewerk	West Germany

SOURCE: Office of Technology Assessment, from data in *Jane's All the World's Aircraft, 1990-91*, 81st ed. (Surrey: Jane's Information Group Ltd., 1990).

Photo credit: U.S Department of Defense

The French Mirage 2000 is flown by the air forces of Abu Dhabi, Egypt, India, Peru, and Greece. France generally does not cooperate in European or U.S. fighter programs; it has decided to build its own fighter, the Rafale, now under development.

structured, with the United Kingdom and Germany each receiving 33 percent of the workshares, while Italy receives 21 percent and Spain, a relative newcomer to European collaborative efforts, will receive 13 percent. Each nation produces certain portions of the aircraft, but all have their own final assembly lines. This redundancy is claimed to increase total unit cost by less than 10 percent, and is considered an acceptable cost for maintaining an important domestic defense industrial capability.

Once the hurdles of project definition and initial set-up are passed, this mode of organizing appears to work reasonably well. However, there are difficulties. Because domestic employment and balance of payment considerations rank high with each national participant, workshares are subject to intense scrutiny (down to two decimal places in the case of Tornado) and force costly and artificial modifications in production plans.

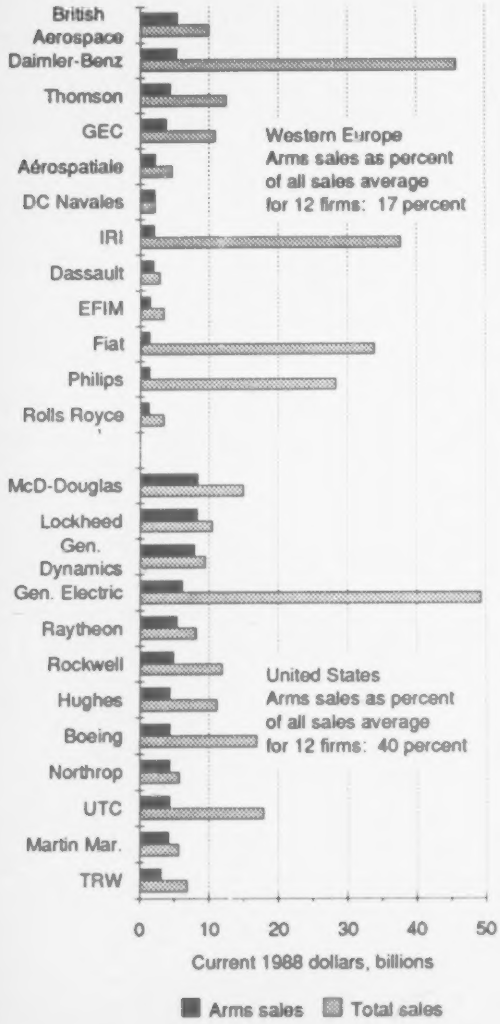
A more serious problem for consortia arises in export marketing. As a practical matter, the participating country that is designated "project leader" retains control over exports, where prices and profits are much higher than for units purchased domestically. Such "excess profits" are not shared among consortium members, a situation that rankled other Tornado participants when British Aerospace reaped a $14 billion windfall return with its defense equipment sales to Saudi Arabia. French withdrawal from the EFA consortium, while ostensibly over differences with other members on mission and design parameters, was in essence prompted by rivalry with the United Kingdom on project leader designation and export profit potential. The French decision to press ahead with its own indigenously produced lightweight export-oriented fighter Rafale has not yet produced the sales results anticipated.

While intra-European alliances among defense suppliers are intense and complex, and bear a resemblance to the phenomenon of global industrialization, there is not yet such a thing as a truly multinational defense producer. The relationships between the national governments and their defense industries are much stronger and more permanent than the ties between the industries themselves. The national governments in the United Kingdom, France, and Germany subsidize their industries both directly and through preferred defense procurements, are active in promoting their industries' exports, and in many cases own stock in their defense companies. A brisk movement of managers between the national procurement executive and the defense industries is not only tolerated but actually encouraged: as one French Ministry of Defense official put it, "we have a revolving door and are proud of it." The differences in government-industry relationships between "free trade" Britain and "statist" France seem more a question of style rather than substance. They are more alike than industry-government relationships obtaining in the United States, where the government encourages competition among domestic suppliers, controls much more closely their exports, has no industrial proprietary interests, and discourages revolving door practices.

The net result of the restructuring that has occurred thus far makes the European arms suppliers more like their U.S. counterparts in terms of size (see figure 4-5). However, the dissimilarity between U.S. and European prime contractors has become more pronounced with regard to the amount of defense work as a proportion of overall activities: most of the major European suppliers fall well below the 60 to 80 percent range common for the U.S. primes.

The mergers at the European prime contractor level appear not to have substantially reduced employment in the concerned industries. The real trimming down appears to be occurring at the subcontractor level, as the primes take on more self-subcontracting. The European firms that seem to be in the most trouble are the small and medium-sized organizations heavily dependent on

Figure 4-5—Sales of 12 Largest Western European and U.S. Defense Firms, 1988



Western Europe
Arms sales as percent
of all sales average
for 12 firms: 17 percent

United States
Arms sales as percent
of all sales average
for 12 firms: 40 percent

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbook 1990, *World Armaments and Disarmament* (Oxford: Oxford University Press, 1990), pp. 326-328.

defense contracts that, through weakness in technology or financing, are unable to attract teaming partners. The problems these small firms face are remarkably similar on both sides of the Atlantic:

- dependence on one or a small number of buyers,
- concentration on military technologies,
- emphasis on military specifications in design and production,
- difficulties in adapting to commercial production (due to company culture and marketing practices), and
- lack of government support for finding new markets or development of new products.

Sometimes national laws work against the survival of these small and troubled firms. In Germany, for instance, regulations on thresholds for union organization make it extremely difficult for firms with more than 15 employees to reduce employment. The only alternative for such firms, in the face of declining sales, is to go out of business. In turn, the regulatory environment has created a niche for extremely small firms, of 14 employees or less, which can be more flexible in adapting to market fluctuations but are less able to market products or arrange financing.

The trimming of European defense production surplus capacity is occurring at different rates in the various defense sectors. The aerospace and electronics sectors have thus far been spared major cuts. This is due to their close association with the civil industries that European governments wish to promote, the greater possibility for export sales, and their adaptability to meet new defense requirements, such as disarmament monitoring. On the other hand, the more traditional defense industries—armor, artillery, munitions, and naval construction—appear slated for much sharper paring.[12]

The conversion record of European defense industries to civilian purposes appears to offer few outstanding success stories. Selenia, a major Italian electronics firm, reports it was able to capitalize on its experience in defense air traffic management to win major contracts for civil air traffic control installations. Beyond this rather obvious example, other defense industry representatives express considerable reservations about an easy direct conversion from defense to civilian work, emphasizing the differences in standards, quality control, quantities of production, and marketing practices.

However, since none of the major prime contractors are predominantly reliant on defense work, and the compartmentalization of defense and civilian operations of these organizations is not as strict as in the United States, the chances for civil conversion seems greater in European industries. A Deutsche Aerospace representative noted, for example, the possibilities for synergy with Daimler-Benz autos in the area of advanced controls display. This type of cooperation between General Motors and Hughes Aircraft would be much more difficult to arrange. In general, European companies aim toward a gradual migration of personnel from defense to the civilian divisions within the same industrial organization, as job opportunities arise.

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[12] de Briganti and Hitchens, op. cit., footnote 2, pp. 15, 30.

U.S.-EUROPEAN ARMAMENTS RELATIONS IN THE POST-COLD WAR ERA

The collapse of the Warsaw Pact threat and the inception of the war against Iraq may lay the basis for shifting the focus of the transatlantic dialogue from preparation for a common defense to controlling arms exports. Some of the sharpest and most hotly contested issues developed within the NATO Alliance over the past 20 years concerned questions of arms sales, technology transfer, standardization, interoperability, and the numbers, types, and quality of conventional weapons systems deployed. The United States urged its Western European partners towards greater standardization and interoperability of weapons and larger front line deployments of armor, artillery, and munitions.

In return, the Europeans complained of excessive and unwarranted U.S. demands for conventional armaments and the imbalance in the "two-way street" of arms sales between the United States and Europe. However, discussion of these issues usually could be contained within a relatively small circle of Allied military leaders, their parliamentary counterparts, and the NATO bureaucracy, all of whom had strong professional and institutional interests in avoiding public debates over the basic purposes of the Alliance.

With the Warsaw Pact threat receding and the dangers of uncontrolled arms exports much in evidence, it becomes clearer that conventional armaments policies reflect fundamental differences between the United States and the Europeans, not only in the military sphere but the economic sphere as well. U.S. participation in NATO was, in the main, directed by strategic and military considerations. U.S. military and political leaders believed the threat of Warsaw Pact conventional attack was real and imminent, and that countering it required a credible NATO conventional defense.

The Europeans, on the other hand, and particularly the West Germans, saw little difference between a devastating conventional conflict fought on their soil and nuclear war and, further, that a fully conventionally armed NATO might induce the Soviets to believe that a conventional attack might be fought in Europe without escalation to a nuclear exchange. Thus, on purely geostrategic grounds, there was a sharp difference between U.S. and Western European policy regarding conventional armaments.

For the first three decades of NATO's existence, the Europeans felt themselves to be lagging behind the United States in both military and civil technology development. The Europeans believed the path to regaining material prosperity was through capturing international markets for manufactured goods, particularly in the high-tech area. In most European NATO countries, some form of concerted action by government and industry was undertaken to catch up. European insistence on licensing and coproduction, rather than purchase, of U.S. weapons systems beginning in the 1960s was an important facet of the strategy of tapping into leading edge U.S. technologies for the purpose of creating a high-tech industrial base that could eventually compete with the United States in both civil and military markets (see figure 4-1).

The German aerospace industry in the Munich area provides an object lesson in how well this strategy has succeeded. The industry was reconstituted there primarily through licensing and coproduction of the F-104 Starfighter. Building on this experience, the industry later was able to participate in production of the all-European Tornado, which successfully competed with U.S. fighter-bombers in both NATO and third-country markets. Presently, the industry, now consolidated into the industrial giant Daimler-Benz-Deutsche Aerospace, is a major partner in the development of the European Fighter Aircraft (EFA), another competitor to present and future U.S. military aircraft. A number of the key personnel now heading the EFA project in Munich had their professional apprenticeships on the F-104 project, living tributes to the durability of German industrial strategy in the aerospace industry. Furthermore, the civil side of the aerospace market was not neglected. Daimler-Benz-MBB is also a major

Photo credit: U.S. Air Force

The Lockheed F-104G Starfighter overcame many of the problems that plagued earlier models, and was a hit with many air forces, though not the U.S. Air Force. It was license-produced and flown in Japan, West Germany, Canada, Belgium, Italy, and the Netherlands, and contributed substantially to the development of the military aircraft industries in those countries, especially Japan, West Germany, and Italy.

participant in the Airbus series development and production. While this aircraft is still heavily subsidized, and long the subject of civil trade disputes between the United States and Europe, it has managed to capture 25 percent of the former U.S. world monopoly on wide-body civil aircraft.

Thus, the policies of the major European arms suppliers (France, the United Kingdom, and Germany account for over 80 percent of West European production) may be characterized as primarily oriented by economic rather than strategic considerations. The disputes between the United States and Western Europe over NATO armaments can be seen to be the fruits of a mutual misreading of the partners' national strategies and aspirations. The U.S. demands for greater interoperability, standardization, and even cost effectiveness of NATO weapons systems were seen by the Europeans as an attempt to capitalize on the much greater American investment in military technology and the cost advantage of longer domestic production runs to promote U.S. arms exports to Europe.

Likewise, American insistence on greater European investment in armor, artillery, and munitions appeared to the Europeans as an attempt to force the European arms industry into the lower tech, less exportable, and less dual-use capable end of the production spectrum. The continuing disputes in the Coordinating Committee (CoCom) over exports of dual-use technologies, and U.S. controls over reexports of licensed technology to Europe was interpreted by many Europeans as motivated largely for U.S. economic advantage, as such controls inhibited the ability of European contractors to develop weapon systems, which of necessity relied on some U.S. subsystems or components. Though it has taken some time, Western European arms manufacturers are increasingly turning away from U.S. suppliers and are dealing with each other, to avoid entanglement in U.S. arms export regulations.

Thus, the role of NATO in coordinating and guiding armaments development and production among member nations has steadily diminished. European unwillingness to cede NATO any real influence in armaments decisions is reflected in the coordinated front they present in the Eurogroup, increased activity within the IEPG, and by the numerous European-only, project-specific industrial ventures and alliances. The official NATO approval of a new European weapons proposal is expected only as an acknowledgment of a fait accompli. As an example, when asked what benefit the EFA derived from its NATO designation, a top management official responded that it provided a means for tax-free salaries for scarce engineering talent. Another example of the prevailing European attitude is the remark of a French adviser to the NATO Conference of National Armaments Directors (CNAD): asked about the role of CNAD, he responded that it cannot function as a "top down" organization, and that its chief benefit is in organizing numerous Working Groups, which provide opportunities for

Photo credit: U.S. Department of Defense

The Panavia Tornado program involves the United Kingdom, the Federal Republic of Germany, and Italy. It was a pioneering program in European military aerospace, and built on earlier Lockheed F-104 Starfighter licensed production.

informal discussions among experts and manufacturers similar to those provided by weapons trade expositions. The failure of the Alliance to develop significant cooperative projects, despite the considerable financial stimulus offered by the 1986 Nunn Amendment, is perhaps the most conclusive proof that NATO's ability to foster transatlantic armaments cooperation has passed.

However, the failure of NATO to serve as an effective umbrella organization for European defense industrial activity does not mean that European defense industries do not thrive. On the contrary, a great deal of defense industrial development takes place, for the most part within each country on a company-to-company basis as noted above.

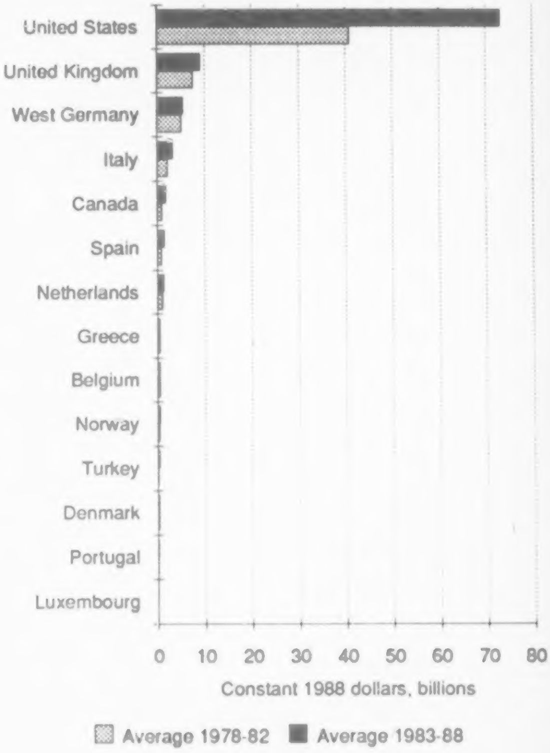
TRANSATLANTIC DEFENSE INDUSTRIAL ISSUES FOR THE 1990s

The United States and Europe present different strengths and weaknesses as they enter the post-Cold War era. At present the United States still leads Europe in its ability to design and produce the highly sophisticated weapons systems desired by third-country customers. The United States starts with a nearly three-to-one advantage over Europe in military R&D spending. In addition, Department of Defense (DoD) procurement is nearly three times that of the combined domestic procurements of Western Europe, insuring for U.S. producers a significant edge in terms of economies of scale over European competitors (see figure 4-6). It is not surprising that the United States, with an average of $15 billion in arms exports annually, is the single largest Western arms exporter.

However, until the downturn in European arms exports, which occurred after the end of the Iran-Iraq war in 1986, combined Western European arms exports approached and even exceeded U.S. levels (see figure 4-3 above).

Due to the radical restructuring of European defense industries, underway since the mid-1980s, the major European defense industrial nations are now collectively in a better condition than their U.S. counterparts to withstand the economic and technological challenges of the 1990s. Almost all the European prime contractors are now embedded within large industrial conglomerates whose markets are predominantly in the civilian sector, thus providing a financial cushion for anticipated weak and erratic domestic and foreign defense sales. These organizations have developed an intricate web of industrial alliances and teaming arrangements with other European producers to take advantage of new export opportunities as they arise. The civilian/defense technology barrier is much more porous within these organizations than is the case with U.S. suppliers. This allows civilian sector technologies, often more advanced than similar defense technologies, to flow easily into the defense sector. By contrast, many U.S. prime contractors must labor under heavy specialization in the defense sector, prohibitions against domestic alliances, and DoD procurement regulations and practices that make it difficult or impossible for technology to be transferred from civilian to defense purposes, or vice-versa.

Figure 4-6—NATO* Procurement Expenditures, 1978-82 and 1983-88



* Not including France

SOURCE: Office of Technology Assessment, 1991.

European nations have foreign trade policies that strongly influence their defense research, development, and procurement decisions. These policies are consistent, long-range, and fully articulated, and are designed to promote the domestic development of such fields as electronics, aerospace, telecommunications, and computers, which are technologies and branches of industry with high export potential. As discussed earlier in the case of Deutsche Aerospace, a vital component has been the defense industry: first as a way to acquire advanced U.S. technology and know-how, which is then used to displace U.S. imports domestically; and then as a means compete with the United States in defense export markets and ultimately in global civilian high-tech markets as well.

The United States, too, can be said to practice "industrial policy" of a sort. Every DoD procurement is the product of a policy decision, and these policies tend strongly to favor domestic producers. However, there are enormous differences in U.S. and European approaches. European governments spend a great deal less of their revenues to support defense R&D and a great deal more to support civilian projects than does the United States. In the United States, defense claims on average 28 percent of the Federal budget, compared to only 7 percent for European NATO members.

In Europe, defense procurement and production decisions are usually the result of government-wide consultations among the senior permanent bureaucracy, with the ministries of trade, industry, foreign affairs, and finance having at least equal voice to the military. Defense producers and financial institutions, which are frequently wholly or partially owned by the government, are also intimately involved in the planning. The civilian and military officials concerned generally have career-long commitments to a defined set of issues.

Also helping to keep long-term strategy on track is the relatively weak role of the European parliaments in defense industrial policymaking. Parliaments retain the power to set an upper limit on the defense procurement budget, but this turns out to be a poor tool for influencing basic strategy since these budgets are multiyear and there is little or no control over line items. European parliaments also generally have little investigatory power on how these budgets are expended.

All this sharply contrasts with the situation in the United States: lack of clear defense industrial goals, concentration of decisionmaking within DoD and the defense committees of Congress, ambivalence concerning defense exports, and failure of DoD to meet the modest tour-of-duty goals mandated by Congress for weapons project managers.

The Europeans value any exports, including military, for domestic employment, balance of trade, national prestige, etc. However, defense trade has other peculiar aspects that raise its importance in the European perspective beyond other export commodities.

First, there is the issue of economies of scale and national sovereignty. The major European powers wish to maintain an independent capacity to produce advanced weapons systems. Even with intra-European collaboration in production and procurement of weapons, the shrinking domestic markets and huge R&D costs (estimated at $36 billion for the European Fighter Aircraft alone) lead Europeans to believe that exports are essential for the viability of their defense industrial base. Second, exports of weapons and weapons production technology can have large multiplier effects. For example, the U.K.-led sale of Tornado fighters to Saudi Arabia opened the door to an estimated $40 billion of civilian trade with the Saudis.

Beyond this is the structural issue of the European defense industrial base. As noted earlier, European defense industries have evolved into national monopolies, closely aligned with their respective governments. This lack of domestic competition would seem a recipe for creeping rigidities in production and marketing practices. To prevent that outcome, government procurement policies are designed to keep the industries competitive and hungry for international business. The French Ministry of Defense, for example, will only support 50 percent of defense R&D costs; the rest must be earned through export sales. A related stimulus for keeping a competitive edge in technology is the necessity to remain attractive as a partner for teaming arrangements with other European arms producers, again, with the export potential of the collaborative project being a major consideration.

With decreasing East-West tensions, the focus of questions facing defense policymakers in Europe and the United States will increasingly shift from the predominantly military sphere—how to protect the

Alliance from a direct military threat—to issues in which economic and commercial considerations will play a more prominent role. In particular, arms exports and their relationship to domestic high-technology employment and the international balance of payments will loom larger in transatlantic armaments relations. To be sure, as Saddam Hussein has demonstrated, such sales can pose military threats to the exporting nations. But at least for the present these risks are much less than the challenges that faced the Alliance during the height of the Cold War. The defense production relationship between the United States and Europe will thus evolve from a primarily strategic alliance to one in which both sides may collaborate or compete for defense export sales, or cooperate in limiting such sales.

Chapter 5

Israel's Defense Industry: Evolution and Prospects

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Chapter 5

Israel's Defense Industry: Evolution and Prospects

INTRODUCTION AND OVERVIEW

The origins of Israel's defense industry can be traced to the small clandestine arms manufacturing facilities of the Jewish Yishuv in Palestine. After gaining independence in 1948, the newly born state absorbed these facilities within the Israel Defense Forces (IDF) and the Ministry of Defense (MOD). It gradually expanded and upgraded these state-owned facilities to meet the state's security requirements and modest industrial capabilities of the time. By 1967, Israel possessed an impressive indigenous capability (for a developing country) for arms maintenance, retrofit, licensed-production, and in some cases, weapons development as well.

Following the French arms embargo against Israel in 1967, Israel embarked on a highly ambitious course of expanding, diversifying, and modernizing its defense industry. The goal was to develop an industrial capability to meet most, and in certain areas all, of the state's weapons requirements. To meet this self-sufficiency goal, a massive investment of human and financial resources was made in the defense sector. Consequently, by the early 1970s the Israeli defense industry, which by this time consisted of many private as well as public corporations, was able to develop and produce domestically a range of advanced weapons systems. In addition to a main battle tank, a self-propelled howitzer, a jet fighter, missile fast patrol boats, and mini-remotely piloted vehicles (RPVs), these weapon systems included a broad spectrum of ammunition and firearms, missiles, avionics, communications, and electronic warfare systems. Some of these systems nonetheless continued to contain foreign (especially U.S.) components, most prominently tank and jet engines.

Although domestic arms requirements have been the principal driving force behind the industry's growth, its surplus capacity was increasingly directed at foreign markets, especially in Latin America, Southeast Asia, South Africa, Iran, and Western Europe. By the middle 1980s, Israel was exporting approximately $5 billion in arms per year. This level of exports was achieved largely due to the reputation of the industry's products, a reputation that owes much to the IDF's combat experience and the uniquely intimate cooperation between the weapons developers and users in Israel. These sales advantages more than offset several severe limitations of the Israeli defense industry, most prominently formidable foreign and domestic political barriers to Israeli defense sales, as well as scarce financial resources to support exports through provision of easy long-term credit.

Despite the industry's export gains, its growth and diversification peaked in the early 1980s, and has since 1984 been partially reversed. The industry was severely hit by a combination of global as well as Israeli-specific factors. These consisted of increasingly intense global competition for shrinking procurement funds, loss of several lucrative foreign clients (initially Iran and ultimately the Republic of South Africa as well), and sustained severe cutbacks in the Israeli defense budget, in particular for domestic arms procurement. Consequently, since 1985 the industry has been forced to undergo a painful readjustment to the new market realities, which has profoundly transformed the industry. The total workforce was cut significantly, sounder financial management techniques were introduced, marketing was increasingly reoriented toward the export (most prominently U.S.) market, specialization and concentration in several military product areas were emphasized, and modest diversification into civilian products was introduced (see tables 5-1 and 5-2).

The readjustment of the Israeli defense industry has met with considerable short-term success, and by 1990 the industry had accumulated an unprecedented backlog of orders. Yet current market realities still cast doubt over the industry's long-term prospects. Further restructuring seems absolutely necessary for the survival of many Israeli defense firms. Privatisation of certain state-owned defense

Table 5-1—Israel's Defense Industries: Main Developments

	1985	1987	1989
Total sales (index 1985 = 100)	100	99.9	95
Exports as a percent of sales	47	55	59
Number of workers	62,600	61,600	46,500
Sales per worker (dollars)	55,000	56,000	70,000

SOURCE: Economic Advisor to Israeli Ministry of Defense.

Table 5-2—Basic Data on Principal Israeli Defense Firms, 1989

Company	Turnover (millions of $)	Employees (thousands)	Exports (as a percent of sales)
IAI	1,248	16.1	75
IMI	525	12.1	63
Tadiran	654	7.1	41
Rafael	355	5.8	25
Elbit	158	1.8	62
El-Op	104	1.2	28
Elisra	104	0.9	41
Ordan	67	0.5	55
Rada	22	0.2	82
Zikon	20	0.2	61

SOURCE: Economic Advisor to Israeli Ministry of Defense.

corporations is under discussion, although its prospects seem slim given the diminishing attractiveness of defense business. Thus, the most likely future course of development for the industry is further acceleration of earlier trends toward diversification, domestic consolidation, product specialization, and cooperative international ventures, especially with U.S. corporations.

CAUSES OF THE CURRENT PREDICAMENT OF THE INDUSTRY

The Israeli defense industry has experienced considerable turbulence since the early 1980s. The performance of the industry has been adversely affected by a combination of broad international as well as unique Israeli developments.

Impact of General and Universal Developments

Over the past two decades, the international arms market has changed from an oligopolistic sellers' market to a highly competitive buyers' market. This transformation has come about as a result of several interrelated developments affecting both the supply and demand for defense equipment.

One supply-side development has been the emergence of many new weapons producers (especially in Southern Europe and the developing countries), as well as the growth in size, diversity, and sophistication of already established defense industrial producers (e.g., Brazil, India, and Israel). Another important development has been the liberalization and commercialization of arms export policies of most traditional weapon manufacturers (notably the Soviet Union and the United States, the People's Republic of China, Germany, and even Switzerland and Sweden as well). These have come about on top of the already lenient weapon export policies of other traditional Western arms producing nations (e.g., France and the United Kingdom).

The impact of these supply-side developments on the structure of the market was enhanced considerably in the 1980s by a decline in the global demand for conventional arms. This decline was caused by a combination of economic constraints on arms procurement and diminishing defense requirements. The economic constraints are attributable in part to lower oil revenues, higher social welfare expenditures, and the diminishing purchasing power of defense budgets caused by the rapidly escalating costs of modern weapons systems. The lower requirements for weapons may be traced to easing of interstate tensions in several prominent global and regional contexts.

The transformation of the international arms market has had a profound impact on the patterns and terms of weapons trade. Specifically, upgrading existing platforms and purchase of defense technology (through licensed production and other business arrangements) occurs in place of much new procurement. In addition, extensive countertrade (barter and offsets) provisions and generous long-term financing have become the norm in procurement of defense equipment, especially by developing countries. Finally, bilateral and multilateral international joint ventures for development and production of defense products have grown significantly in both number and importance. They are commonly sought as a means to diminish the rapidly mounting risks and costs inherent in new weapons development and to secure access to both technology and foreign markets. This process has been made possible by a lower degree of product differentiation as well as the growing potential for customization through modification of software and sub-systems rather than substantial alteration of basic platform design.

These developments have exerted significant and adverse influences on the Israeli defense industry. The overall decline in demand for arms came about precisely at the time that the indigenous Israeli arms industry had become increasingly dependent on exports (see table 5-3). Moreover, by virtue of its

Table 5-3—Ratio of Exports to Sales for Leading Israeli Defense Companies (percent)

	1985	1989
Israel Aircraft Industry (IAI)	60	75
Israel Military Industries (IMI)	81	63
Elbit	55	62
Rada	49	61
Rafael	40	25

SOURCE: Economic Advisor to Israeli Ministry of Defense.

small size, limited resources, and minuscule civilian market, Israel found it exceptionally difficult to provide long-term financing and countertrade opportunities to support the export drive of its defense corporations. Joint ventures and technology transfer have also proven especially problematic for Israeli defense firms due to the combination of Israel's political isolation and its tight secrecy requirements on defense technology.

From an Israeli perspective, the only positive aspect of these trends has been the ascendancy of defense systems modernization and upgrading. Here, rather than in the production of main combat platforms, Israeli defense corporations have a relative advantage over their foreign competitors, an advantage stemming largely from the extensive operational and combat experience available to the industry through the IDF.

Impact of Israeli Specific Factors

The growth of the Israeli indigenous arms industry has always been constrained by severe structural limitations on the size of both the domestic and foreign markets for its products. The domestic constraints result from the limited size of the local arms market, whereas the foreign market constraints are grounded in Israel's political isolation.

Israeli companies and products are politically barred from entering a sizable segment of the global arms market—the Arab nations and most of the Islamic world. In addition, other potential markets in Europe and the Far East are strictly off-limits for any defense product bearing a clear Israeli identity or are easily traceable to Israel. Similar if slightly less severe inhibitions also apply in these regions to joint ventures involving Israeli companies. Moreover, Israeli defense corporations are prohibited from selling many products (and to several prominent potential foreign clients), due either to Israeli political sensitivities or U.S. pressures (e.g., South Africa and Iran). Sales restrictions on transfer to third parties of defense products containing U.S. components (e.g., Israeli-made jet fighters or tanks using American-made engines) also apply.

Operational and security requirements constitute a further barrier to Israeli companies seeking to export some of their more advanced indigenous products to certain lucrative but politically unreliable foreign customers. Finally, Israeli companies face broad protectionist tendencies prevailing in some of the world's largest arms markets (the United States, Western Europe, and Japan).

The cumulative effect of these factors is to restrict severely the share of the arms market accessible to the Israeli defense industry, even before economic and industrial considerations are introduced. These, in turn, further complicate the picture for the industry.

Some of the more salient features of the Israeli arms industry that affect its export prospects are its size and complexity. The tremendous post-1967 growth in size, diversity, and sophistication of Israel's defense industry has been driven almost exclusively by domestic defense requirements. Still, this growth was initially beneficial to the industry's export potential as well, enhancing its appeal as a viable alternative supplier to the major powers who had originally dominated the market.

By the mid-1980s, however, the industry's size and sophistication began to dampen its export potential. By this time Israel was sinking much of its energy and resources into the production of main combat platforms, which it could not export due to political restrictions. Moreover, by virtue of their sophistication, many of the industry's products no longer appeared suited to Israel's traditional customers in the lower end of the market, whereas the potential customers for the more advanced products seemed to lie in politically problematic markets for Israel (Western Europe and the United States). Furthermore, Israeli defense corporations would no longer vie for small but profitable specialized niches in the market, but choose to compete for the big contracts, which inevitably pitted Israeli defense corporations against some of the industry giants, severely curtailing profit margins in the process. Finally, entry of many new suppliers into the lower end of the market, many of which enjoy the benefit of cheap labor, have largely displaced Israeli companies from some of their more profitable traditional export product lines (e.g., mortar, tank, and artillery ammunition).

All of these export-related problems of the Israeli defense industry deepened in the 1980s. This has been the result of the overall developments on the international arms market, continuation and exacerbation of the Israeli industry's specific structural constraints, and finally the loss (due to political factors) of two of its most highly valued clients (initially Iran and then, gradually, South Africa as well). The "peace dividend" of recent developments in Europe looms on the horizon as another major setback to the Israeli defense industry. The Federal Republic of Germany, in particular, was the largest Western client of the Israeli defense industry. In the wake of reunification of Germany and the conclusion of the Conventional Forces in Europe (CFE) talks, this market may deteriorate as well.

The adverse developments on the export front have coincided with bleak economic conditions in Israel. Since the early 1980s, the industry has increasingly depended on foreign sales for its prosperity, in some cases even for the survival of firms. The economic situation in Israel has not only undermined the defense industry's domestic sales but has also, in many cases, deprived the industry of one of its leading export leverages—the so called "IDF stamp of approval" for its products attained through prior sales to the IDF.

Rising government deficits, inflation, and foreign debt coupled with heavy cumulative investment in modernizing and expanding the ranks of the IDF in the post-1973 Yom Kippur War period have forced successive Israeli governments since 1983 to cut and then freeze the local component of the Israeli defense budget. The budget was cut from an annual average of roughly $3.2 billion from 1973 until 1983 to roughly $2.6 billion per year since. During the same period the second component of the Israeli defense budget—U.S. military aid—has remained largely stagnant, frozen at the level of approximately $1.8 billion per year. In real terms, it has declined significantly particularly in comparison to the rapidly escalating costs (above and beyond inflation) of defense products.

The decline in both components of the defense budget took place at a time when the defense establishment was engaging in unusually heavy operational activity, initially in the context of the war in Lebanon (1982-85) and the Palestinian uprising in the occupied territories (since 1987). Although the operational costs in each case amounted to several billion U.S. dollars, the Israeli defense establishment was forced to absorb some of the costs within its already depressed budget. But despite the severe defense budgetary crisis since the early 1980s, the IDF order of battle was only cut back slowly and modestly during this period. Consequently, it was defense procurement that absorbed the cost of the defense budget crisis.

Two factors contributed to the financial crisis of the Israeli defense industry. One is the diminished buying power of the depressed Israeli currency. Most of it is naturally spent on salaries, infrastructure, operations, and the like. The other is the U.S. stipulation that most of its aid to Israel (all but $400-$450 million in offshore procurement funds) be spent on procurement of American goods. Israeli defense procurement thus had to be increasingly reoriented toward U.S. sources. Recently, budgetary constraints have tightened to the point that the Israeli MOD finds it necessary to divert to U.S. suppliers' purchases of certain items it has traditionally bought locally. This diversion has been deepened by the government's economic policy, which has held constant the rate of exchange between the Israeli currency and the U.S. dollar for extended periods while inflation and labor costs have been steadily rising at an average rate of roughly 15 percent. The adverse impact of this policy on the indigenous industry's competitive edge in general, and on competition with U.S. suppliers in particular, is clear.

The burden of the defense budget crisis of the 1980s was not allocated evenly within the indigenous defense industry. Certain government-owned corporations (Israel Aircraft Industries (IAI) and to a lesser extent Rafael) were spared some of the cuts and/or compensated for much of their losses. IAI, in particular, enjoyed preferential treatment due to its strong domestic political clout. It has been receiving by far the greatest share of the offshore procurement component of U.S. military aid to Israel, initially for the Lavi jet fighter project, and since cancellation of the Lavi in 1987 for some of its substitutes. Most public and private defense companies were, consequently, quite severely hit; many of their contracts were stretched, scaled back, or terminated outright.

READJUSTMENT OF THE ISRAELI DEFENSE INDUSTRY: 1984-90

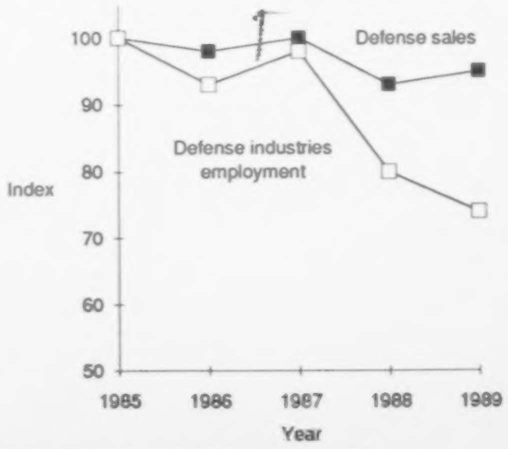
Signs of the crisis awaiting the Israeli defense industry were evident in the early 1980s. Yet its magnitude and severity, its underlying causes, and most importantly, its enduring nature, were not initially understood. Defense budget cuts were widely believed to be transient; many defense industrialists expected to be compensated for them within a year or two. Moreover, hefty financing profits (facilitated by an inflation rate of 600 to 800 percent) permitted many defense firms to gloss over operating losses. Thus, it was not until at least 1984 that tight defense budgets were seen as a permanent condition. The successful introduction, at that time, of a government economic plan to curb inflation eliminated almost overnight the paper financing profits of the industry, adding a sense of urgency to the need to readjust quickly.

One major factor affecting the adjustment strategy of Israeli defense firms was the widespread perception that global arms markets would provide ample business opportunities. The first reaction to the domestic sales crisis consequently was an intense arms export drive. This drive was undertaken by individual firms with strong encouragement and backing by the Ministry of Defense. The Minister of Defense at the time, Itzhak Rabin, made it clear to the defense industry leaders that he thought the "industry was oversized for Israel's needs" and that "only those who would export would survive." Even Rafael, the Israeli company that most closely resembles an American national laboratory, was forced to go beyond R&D to full-scale production and ultimately to exports as well.

To improve the industry's export prospects, the Ministry launched an intense diplomatic drive to promote sales to and industrial cooperation with the United States through a series of Memoranda of Agreement (MOAs) and Memoranda of Understanding (MOUs). Similar, though less intense efforts were directed at West Germany and (according to foreign press reports) South Africa. The arms export drive met with considerable short-term success, at least in terms of the volume of sales. From 1984 through 1987 Israeli defense exports exceeded $0.5 billion, and the industry had accumulated an unprecedented backlog of orders exceeding $3.5 billion. Furthermore, between 1985 and 1989 the industry's exports rose sharply from 47 percent to roughly 60 percent of total sales. Yet the profitability of much of the arms exports was at best marginal. The industry, primarily state-owned, had put on fat during the years in which it operated mostly in the sheltered environment of the captive domestic market. But the new budget realities precluded continued government subsidization of domestic arms manufacturers and forced significant decreases in government R&D support.

Facing intense competition in the global defense marketplace, the defense industry was forced to accompany its export drive with intense efforts to reduce costs and increase efficiency. For example, industry cut back dramatically on investments and corporate-financed R&D budgets. The former have declined by roughly two-thirds between 1985 and 1989, while the latter dropped on average by roughly 40 percent. In addition, over the 1985 to 1989 period, the defense industry has reduced its workforce by approximately 25 percent (from a total of 62,600 to 46,500) while only experiencing a 5-percent drop in total sales (see figure 5-1). Average annual sales per employee in the industry have consequently risen during the period from $55,000 to a somewhat more acceptable level of $70,000. This figure fails to

Figure 5-1—Change in Israeli Defense Sales and Employment, 1985-89



SOURCE: Economic Advisor to Israeli Ministry of Defense.

reveal considerable variance in efficiency between the individual firms in the industry, which ranges from below $50,000 to over $120,000 in sales per employee. Finally, in order to overcome cash flow problems, many Israeli defense corporations have increased their presence in foreign financial markets, and, in isolated cases, in the U.S. stock market as well.

For its part, the Ministry of Defense has assisted the industrial readjustment process by exercising leverage (as client, and in certain prominent cases owner as well, of defense manufacturers) in order to streamline the industry. Seeking to eliminate wasteful domestic competition, it has applied pressure on individual corporations to sell out, merge, and/or form joint ventures with other Israeli companies operating in the same areas. These efforts have met with partial success, the most prominent case being the merger of the mini-RPV operations of Tadiran and IAI into one company, Mazlat, which was initially jointly owned and ultimately completely taken over by IAI. The MOD has also labored to capitalize on Israel's political clout in the United States and the IDF's appeal as a sizable and prestigious client in order to secure valuable industrial offsets for, and joint ventures with, Israeli companies. These efforts, however, have attained only a modest degree of success, mainly due to Israel's dependence on U.S. grant-in-aid for the bulk of its military procurement.

As for the impact of the readjustment process on the industry's product lines, two developments are apparent in the post-1984 era: specialization and diversification. The industry has been forced to abandon the domestic production of main combat platforms, a dramatic reversal of the pattern established since 1967 of intensive cultivation in Israel of self-reliance in development and production of all major weapons systems. The process, which had culminated in indigenous production of a modern jet fighter (the Kfir) and a light utility transport (Arava), missile boats (Sa'ar 4 and 4.5), tanks (Merkava Mark 1, 2, and 3), and a self-propelled howitzer, has come to an abrupt end. With the cancellation of the Lavi jet fighter program in 1987, the Merkava tank remained the sole locally produced combat platform, and even its production was significantly scaled back. In the future, industry will likely concentrate on development and production of diverse military components and subsystems, as well as a comprehensive upgrade and modernization capability.

Photo credit: U.S. Navy

The Israeli Aircraft Industries (IAI) Kfir delta-wing tactical fighter was developed from the French Mirage V airframe after the French arms embargo of Israel in 1967. The aircraft began flying in 1974, and 212 have been produced. From 1985 to 1989, the U.S. Navy and Marine Corps leased two squadrons for use as aggressor aircraft in training, and flew them under the designation F-21A. In 1989, France agreed to sell to IAI five SNECMA engines, to be used in place of the airplane's General Electric J79 engines. This was part of a renewed effort to market Kfirs without U.S. export restrictions.

The second major product related development in the 1985 to 1990 period pertains to the industry's experimentation with diversification to civilian product lines. These range from card-operated public phon es (Israel Military Industries (IMI)), to diagnostic medical instrumentation (Rafael), civilian aerospace (IAI), and computer accessories (Elbit). This course of action has been pursued with little enthusiasm and considerable apprehension. The Israeli Government's civilian R&D support budget is small. In addition, most Israeli arms manufacturers lack prior experience in a truly competitive environment, much less in dealing with the civilian marketplace. Some defense companies are still recovering from misguided, half-hearted past endeavors in the civilian market (e.g., Rafael in electro-optics, IAI in executive jets, and Soltam in pots and pans). There is widespread concern among defense industrialists that when it comes to marketing civilian products, Israeli companies do not enjoy the same reputational advantage that they have acquired in the defense area.

OUTLOOK FOR THE FUTURE

Meeting the IDF's Procurement Requirements

If a comprehensive Middle East peace settlement cannot be reached, Israel's arms requirements in the 1990s are unlikely to fall below the level of the preceding decade. Despite the United States' leading role in the Persian Gulf War, Israel will continue to rely on the IDF as its ultimate guarantor of security. And the IDF, in turn, will seek to acquire an uninterrupted supply of diverse state-of-the-art military hardware in order to preform its missions. This leaves open the question of how the IDF will meet its future hardware requirements.

Many analysts expect that most future weapons systems procured by the IDF will come from the United States. This expectation, however, is predicated on several critical assumptions. First, it is assumed that the IDF will adhere to its traditional doctrine ascribing a critical role to mobility. This seems a reasonable assumption given the IDF's reluctance to introduce anything but moderate changes in its doctrine to accommodate the ascendancy of firepower over mobility on the battlefield. While firepower requirements could conceivably be satisfied by indigenous sources, the same no longer holds true for main air, sea, and to a lesser extent land combat systems. These, with the exception of a main battle tank, are no longer produced domestically, and will therefore have to be imported in the future.

Assuming further that the nature of U.S.-Israeli political and security ties will not be fundamentally altered, Israel will continue to import almost all of its foreign weapons systems from the United States. Israel, for its part, is unlikely to seek any fundamental change in its intimate security cooperation with the United States. The United States might conceivably do so, however, for a combination of domestic and foreign policy reasons. Short of a profound change in U.S. policy toward Israel, affecting either the magnitude of military aid and/or the willingness to sell arms, a significant reorientation of Israel's defense procurement is highly improbable.

Two additional aspects of the IDF's weapons requirements will affect Israeli procurement. First, the impact of resource constraints, and second, the strong emphasis on operational autonomy and a qualitative edge against its opponents. Severe domestic resource constraints coupled with the rapidly escalating cost of new weapons systems mandate that the IDF stretch to the limit the operational life of existing systems. The actual implication of this requirement is that the IDF, like many of its counterparts around the world, would be spending in the future considerable and growing resources on maintenance, modernization, and upgrading of its existing weapons systems. This is where the second requirement comes in. In order for the IDF to enjoy operational autonomy, overcome foreign export restrictions on supply of state-of-the-art military equipment to Israel, and still maintain a qualitative edge, Israel will likely expand its capacity to carry out maintenance and upgrade work locally.

Alternative Futures for the Defense Industry

Many of the original Israeli rationales for the development of a comprehensive and sophisticated indigenous arms industry still pertain today. However, two factors that have influenced the shape of the industry have changed significantly over the past decade. First, domestic demand for its products has both declined and undergone a profound change in nature. And second, the global arms market has also been markedly transformed. The future of the indigenous arms industry lies in systematic readjustment to the new market conditions. The Israeli defense industry today is significantly leaner and more efficient than it ever has been. Its successful foreign marketing effort in recent years has left it with a backlog of orders that could serve to cushion its restructuring process (see figure 5-2). Yet without more drastic restructuring of the industry, its future may still look bleak. As the Director General of the Israeli MOD, Maj. Gen. (ret.) David Ivri, has recently observed, the industry must complete its transformation over the next 3 years, since by that time it will have largely exhausted its current backlog of orders. This leaves the industry with little time in which to maneuver.

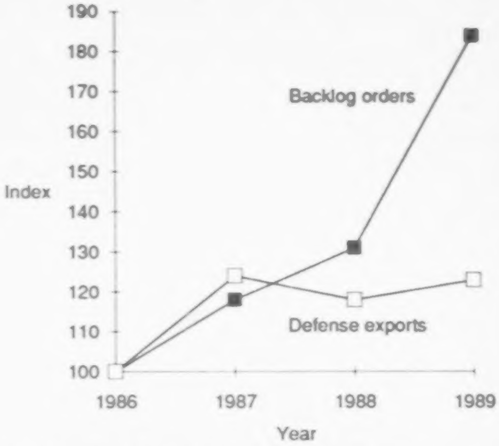
Given these constraints, the Israeli defense industry might embark on a number of different courses. Several involve extension and intensification of the readjustment efforts already underway. These include tighter financial and risk management, improved efficiency and productivity, more conservative corporate R&D policies, continued emphasis on exports, specialization in specific market niches, and diversification into civilian product lines. For most Israeli defense firms, decreasing the share of military business in their overall activity will be critical to long-term survival. Israeli aerospace manufacturers (e.g., IAI and Elbit), who have long maintained a presence in the civilian market, are finding the transition to civilian products easier to make, despite the formidable political barriers to Israeli participation in collaborative (especially European), nondefense, projects. Elbit has already attained a 50:50 civilian to military sales ratio (up from a 30:70 ratio several years ago), while the much larger IAI is struggling to increase civilian sales from 12 to 20 percent of its business.

Other Israeli defense firms, especially those in military electronics, are finding it more difficult to make the transition, but they are also less pressed to do so. Indigenous R&D and production capability in their area is considered essential not only for Israel's security but also for the country's long-term industrial growth. Moreover, demand for their products is unlikely to fall. Still, rising R&D costs and risks associated with the global arms market enhance the importance of economies of scale. Consequently, even Israeli companies in defense electronics are experiencing growing pressures to consolidate their operations. Elbit's much-publicized negotiations for Tadiran's electro-optics subsidiary El-Op is a case in point. Such transactions, however, have proven difficult to make in the heavily unionized parts of Israel's economy, as the abortive merger of Elisra and Tadiran's Systems Division has clearly demonstrated.

Israeli firms in the traditional and specialized military areas such as armor casting (Urdan), mortar, artillery, and ammunition production (Soltam and IMI), and military R&D (Rafael) face the most daunting challenges. They experience far more difficulty in making the transition to civilian products. For them, selling out, scaling back operations, or, in extreme circumstances, even closing down parts or all of their military production lines may well be the only way to go.

Privatization of the key state-owned defense companies is unlikely given the combination of secrecy requirements and the unattractiveness of defense business in the current market conditions. In these cases, changes in the legal status of certain parts of the state-owned arms industry may lead to a more competitive spirit, as well as greater financial and operational autonomy. A change in the status of IMI from direct MOD ownership to government-owned corporation (similar to IAI) has long been expected, and only delayed by last minute technical problems. Rafael may well follow suit before long.

Figure 5-2—Israeli Defense Exports and Backlog Orders, 1986-89



SOURCE: Economic Advisor to Israeli Ministry of Defense.

Ultimately, however, the future of the entire Israeli defense industry hinges on specialization and joint ventures. Specialization in market niches such as missiles, defense electronics, unmanned aerial vehicles, and upgrade and retrofit work is necessary to capitalize on the industry's strength without taxing its resources. The industry will have to concentrate on these areas in order to meet the country's security requirements, as well as to take advantage of its exceptionally skilled engineering capability, the extensive combat experience of the IDF, and the intimate relationship in Israel between weapons designers and users. On the other hand, the industry will have to forego activity in many other areas, especially those that are highly capital intensive and therefore certain to strain Israel's limited financial resources. Furthermore, in the future, the Israeli defense industry will have to stay clear of products whose clear political identification with Israel renders their foreign sale impossible.

Joint ventures are increasingly common in the contemporary global arms market. Until recently, however, Israeli defense firms have taken part in only a handful of such business ventures. Joint ventures between Israeli and European companies are rare and will, in all likelihood, remain uncommon in the foreseeable future. But joint ventures in the defense field between Israeli and American firms are growing in number and importance. For Israeli companies they have proven essential in order to penetrate the U.S. arms market, and in some cases to acquire technology as well. Their principal appeal for American companies, on the other hand, seems to lie in their potential for enhancing market clout through access to off-the-shelf products, specialized Israeli military technology, and invaluable IDF operational and combat experience, although this last factor will become less important in view of U.S. experience in the Persian Gulf War. The cooperation between Mazlat and AAI (mini-RPVs), Tadiran and General Dynamics Electronic Systems (SINCGARS), Rafael and Martin Marietta (air-to-ground missiles and reactive armor), IAI and Lockheed (advanced tactical ballistic missiles or ATBMs) as well as TRW (UAVs) are just a few examples.

Finally, a word regarding the impact of the Gulf crisis and war on the Israeli defense industry. It has led to a significant short-term increase in the local component of the defense budget as well as in the foreign military aid to Israel from both the United States and Germany. These funds have aided several existing procurement programs and the addition of several new ones. Moreover, some of the lessons learned about key weapons systems in the course of Operation Desert Storm are also likely to trigger new orders of both indigenous and foreign weapons. The appeal of several Israeli systems already under evaluation by the U.S. military (e.g., UAVs and mine clearing equipment) might be enhanced in view of the lessons likely to be learned from Operation Desert Storm.

Yet, side by side with these largely positive developments for the Israeli defense industry, several adverse consequences are also anticipated. These include an inevitable medium-term decline in the local defense budget now that the Iraqi threat to Israel has diminished considerably, at least for several years. The defense budget is also likely to be the target of growing demands for resources from other parts of the economy, particularly those associated with absorption of massive immigration to Israel. But the most important setback to the Israeli defense industry will come from the loss of its competitive edge tied to combat experience. Because few Israeli systems were deployed in the Persian Gulf War, their effectiveness in combat could not be evaluated. At the same time, many American, British, and French systems were tested in the war and, consequently, might be further refined. The enhanced appeal of these foreign weapons deployed in the 1991 war is likely to make marketing of Israeli-made weapons more difficult in the future. This constitutes a significant setback in an era of declining defense procurement budgets worldwide.

EVOLUTION OF ISRAEL'S DEFENSE INDUSTRIES

From 1948 to 1967

The roots of the Israeli defense industry predate the founding of the state, with the "Haganah" weapons producing facilities of the early 1940s. These underground facilities gained legal status in 1948 and formed the nucleus of Israel's modern day defense industries. After Israel gained independence, and well into the 1950s, its first Prime Minister and Minister of Defense David Ben-Gurion was instrumental in creating the infrastructure for the expansion of these facilities and the creation of new defense industries.

In his budget message to the Knesset in August 1949, Ben-Gurion spoke of the need to promote domestic production of weapons to avoid dependence on outside sources. During the early 1950s, regional and international conditions contributed to a growing sense of the imperative to expand Israel's defense industries, and the Tripartite Agreement played a central role in this respect. Ben-Gurion faced opposition to the idea of an indigenous defense industry, which was based on economic considerations. By 1953 Ben-Gurion made a number of key decisions that pushed Israel toward greater self-reliance in the area of weapons production:

- The expansion of TAAS (Israel Military Industry), principally a light arms and ammunition industry.
- Reorganization of R&D component of the IDF and Defense Ministry. Ben-Gurion removed the Science Corps from the IDF and placed it (greatly expanded and modified) under the jurisdiction of the Defense Ministry, as Emet.

This research and planning division later evolved into Rafael.

- Approval of the establishment of an airplane maintenance plant, Bedek, which later became the Israel Aircraft Industries (IAI).
- Approval of Defense Ministry's creation of Tadiran, the Israeli Electronics Industry.

The establishment of Bedek and Tadiran and the expansion of IMI in the early 1950s occurred without either significant foreign sources of capital or technological cooperation between Israel and any developed industrial nation. The expansion of these industries and the establishment of new industries, however, were facilitated by West German reparations, as well as by Israel's collaboration with France in coproducing weapons and technology, which began in 1956.

Between 1956 and 1967 the IAI increased the maintenance and repair service that characterized its early years and also began development of the Gabriel sea-to-sea missile. In 1957 IAI decided to produce the first jet training plane, the Fouga Magister, under license from France. Tadiran and IAI also began development of communications and control systems for the IDF, as the existing systems were found to be deficient following the 1956 war. Along with IAI and IMI, Rafael developed a series of air-to-air missiles (Shafrir), a meteorological rocket (Shavit II), and the Luz air-to-ground missile series. The systems developed were tailored to Israel's needs and contributed to reducing dependence on external powers.

There was constant tension, which began in the 1950s and increased during the 1960s, between the MOD and the IDF in arms production. While the IDF preferred to purchase foreign weapon systems that were less expensive, tested and proven, and had a shorter delivery schedule, the MOD maintained that Israel had to pay the price for arms independence. This same controversy was reflected within the government itself: the tendency within Ben-Gurion's political camp, Rafi, was to advocate expanding domestic industries, while members of a competing faction, Mapai, favored greater reliance on foreign purchases. Nevertheless, the defense industries became firmly entrenched during these years.

From 1967 to 1984

A major push forward in the direction of autonomous weapons and aerospace industries came with the gradual deterioration of French-Israeli relations in the early to mid-1960s and finally the French weapons embargo in 1967 and 1968. The French embargo came at a time when Israel had attained a development capability which could be carried over into production. In response to the French decision to halt the delivery of 50 Mirage V fighter airplanes, Israel decided to proceed with the development and production of the Kfir jet fighter. Similarly, when five already-paid-for Sa'ar missile boats were prevented from leaving Cherbourg in France (although they were later brought to Israel in a special undercover mission), Israel recognized the need to build its own missile boat, and decided to build the Reshef class fast attack crafts Sa'ar 4 and 4.5.

The British Government's decision in 1969 to cancel an almost completely negotiated agreement for the supply of British Chieftain tanks, and U.S. refusal to supply Israel with modern M-60 tanks prompted the decision to build the Merkava, designed for the IDF by General Israel Tal, with crew safety a paramount concern (development and production plans became operational only after 1973). However, all engines were either exported to Israel principally from the United States r produced locally under license.

Israel's defense industry was initially concerned with more modest undertakings such as maintenance, repair, upgrades, modifications, and licensed production. But after 1967, on the basis of experience gained in these areas, Israel initiated indigenous design of major weapons. The principal industries as well as many smaller companies initiated new projects and expanded production of weapon systems.

Israel increased investments in R&D funds by 300 percent between 1967 and 1972, and the number of employees in the defense sector almost doubled. After 1973, the defense industries continued to expand production, and began to export arms at a profit. Israel became a major supplier of military electronics and communications equipment and advances in missile technology, which included IAI's Gabriel Mark III antiship missile and a number of air-to-air missiles, placed its electronics industries at the forefront of the field.

During this period Israel and the United States increasingly cooperated in producing technologically advanced weapon systems. Following the 1973 War, Israel became aware of the growing importance of sophisticated weapon systems, yet the high cost, complexity, and rapid rate of technological change in these systems made it difficult to develop and produce all systems locally. Cooperation with the United States in this area was formalized in a number of Memoranda of Agreement. The first significant defense production MOA was signed in 1979. It enabled Israeli firms to participate in U.S. Government contract bidding without the hindrance of Buy American legislation; this MOA also provided for cooperation in military R&D.

While the foundations of an indigenous defense industry were laid during the 1948 to 1967 period, the years until the mid-1980s were characterized by expansion and increased production in the defense industries, which has helped Israel realize partial independence in this field; this includes the ability to produce those weapons most susceptible to embargoes and boycotts, the ability to incorporate incremental technological innovations in large-scale weapons systems, and the ability to produce weapons designed particularly for local requirements.

1985 to Present

This period is perhaps best characterized as the defense industry's retrenchment and restructuring. The most salient aspect has been the cancellation, or cutback of several indigenous R&D and production programs for major combat platforms. These include cancellation of the financially overambitious Lavi jet fighter project by IAI in 1987, cutbacks in production of the Merkava tank, cancellation of local production of missile boats and submarines, and termination of development of an indigenously designed 155mm self-propelled howitzer, Sholef.

The state of the industry during this period is best reflected in a statement made in June 1987 by then Israeli Defense Minister Yitzhak Rabin, who warned the defense industries that the days of indigenous production were over; they would have to reduce their size, develop new markets for export of domestic production, and become more efficient. As for the Ministry of Defense, it would have to reduce its orders from its own industry and reduce R&D in order to keep within the defense budget.

THE CURRENT STRUCTURE OF THE INDUSTRY

The relationship between the defense industries and the Ministry of Defense is historically close, and the four largest firms today—IAI, IMI, Rafael, and MASHA (Renovation and Maintenance Centers-IDF)—are still closely tied to the Israeli Government. Nevertheless, there are nuances of ownership within these government-owned firms, and today's Israeli defense industries also include public and private sector corporations. What follows is a breakdown of the defense industries according to ownership, as well as a brief profile of some of the larger industries.

Inhouse Military Organizations

MASHA—the Renovation and Maintenance Centers within the IDF Logistics Branch—is a prime example of military defense industrial production. One of these Centers has specialized since the 1950s in renovation of armored combat vehicles (World War II halftracks and Sherman tanks). The manufacture of the Merkava was assigned to units within this Center, and since 1978 MASHA has concentrated on production of the Merkava main battle tank. While manufacture of most of the tank's parts was subcontracted, MASHA is in charge of the assembly.

Ministry of Defense Companies

This category includes those companies under the direct jurisdiction of the Defense Ministry. Today, the only company left with this standing is Rafael, as IMI had its status changed in late 1990. Rafael is Israel's weapons development authority, whose traditional task has been to develop state-of-the-art weapon systems. Rafael develops and manufactures missiles, guided and unguided weaponry, electronic warfare equipment, C^3I systems, simulators, thermal imaging devices, and add-on armor for main battle tanks and armored personnel carriers. Rafael has developed over 100 different weapon systems for the IDF since 1967.

Rafael has been among the companies hardest hit by lowered defense budgets in the 1980s. Rafael has traditionally turned over production of its products to IMI and IAI, but in the 1980s Rafael was increasingly forced into production, exports, and to a lesser degree a search for civilian markets in order to sustain its workforce. With a highly sophisticated and highly paid workforce, Rafael has found the transition difficult. The company's cumulative losses until 1988 were $150 million, and in 1989 alone its losses rose by $85 million.

As a consequence, Rafael cut its workforce from 7,500 to 6,000 and experienced severe union problems as a result of these layoffs. The State Comptroller's Report of July 1990 found that Rafael was not measuring up as a viable business enterprise, having failed to formulate and implement a long-term rehabilitation strategy. Domestic sales for 1990 stand at $265 million, defense exports were $110 million, and commercial sales were $5 million. Rafael's current order backlog is $450 million. Projections for 1994 place domestic sales at $290 million, defense exports at $210 million, and commercial sales at $50 million. In mid-March 1991, Rafael's General Manager Moshe Peled claimed that in order to remain competitive, Rafael will require yearly sales of $550 million. Moreover, in light of the company's difficulties, he added that if Rafael does not succeed in laying off an additional 800 employees, it will face a difficult future.

Government-owned Corporations

This category includes firms such as IMI, IAI, Israel Shipyards Ltd., and Bet Shemesh Engines Ltd.

IMI is Israel's most veteran defense industry, with its roots in the prestate years. Its mission is to keep the IDF as independent as possible of external weapons supply sources. It manufactures light arms, ammunition, tank guns, military bridging equipment, air fuel tanks, artillery rockets and launchers, chaff/flare and aerial decoys, and other materiel. Among the weapons produced are the Uzi machine gun and the Galil rifle. Because of the nature of IMI production (emphasis on ammunition and light arms), the company has been extremely sensitive to regional conflicts and wars, with production peaks during periods of war.

The crisis that hit the Israeli defense industries in the mid-1980s led to a reduction of IMI's workforce from the February 1985 peak of 14,615 employees, to 11,500 in late 1990. From 1986 to 1989, IMI suffered losses in the range of millions of dollars—$100 million in 1988 alone. It has also suffered from a marked decrease in foreign orders due to the fact that other countries have entered its market. The MOD spokesman in early 1989 confirmed that between 1986 and 1988 IMI's revenues were cut as a cumulative result of three factors: the rise in cost of local material (in dollars), the reduction of MOD orders, and the slump in international markets, which caused a reduction in export demand, production over capacity, and lowered prices.

In February 1991, IMI formulated a plan for additional personnel cutbacks of approximately 1,000 employees over the next few months (roughly 9 percent of the total workforce), due to the continuous decline in activity and the slump in exports. While exports for 1990 reached $450 million, the expected amount for 1991 is a mere $300 million, a decrease of 33 percent. IMI will most likely record losses for 1991.

Israel's largest corporate employer, IAI, was established as Bedek Aviation in the early 1950s to maintain Israel's Air Force aircraft, but gradually evolved into a full-fledged aerospace industry. An important milestone was the licensed production of the French Fouga Magister jet trainer in the late 1950s and early 1960s, which provided it with essential production experience, setting the stage for an autonomous aircraft design and production capability. Today IAI concentrates on aerospace, electronics, and naval systems, and is comprised of over a dozen separate plants, including the Engineering Division, Aircraft Production Division, Elta, MBT, and Bedek Aviation.

Cancellation of the Lavi and earlier defense budget cuts resulted in major cutbacks at IAI in the second half of the 1980s. The total workforce was reduced from 22,500 employees in 1986 to 17,500 in mid-1988 (3,300 as a direct result of the Lavi), and by early 1989 the workforce was further reduced to 16,000 employees. Yet despite the difficulties, IAI has been relatively sound financially, primarily due to foreign military export opportunities and the transition to space-oriented and civilian markets, which currently account for roughly 15 percent of its business. IAI hopes to raise this to 20 percent by 1995. In the wake of the Lavi cancellation, IAI continues to be active in the new combat aircraft business; moreover, the company turned its efforts to modernization and upgrade, unmanned aerial vehicles, and continued development of electronics and avionics, missiles, and space technology.

Total sales for 1990 reached $1.6 billion, with exports of $1.4 billion. Orders for 1991 stand at $3 billion, and a projected 80 percent of total sales are expected to be exported. While the IAI seems to be recuperating well, the company's program for the development of an executive aircraft, Astra, has been critical. IAI has been accused of unrealistic forecasts concerning the market value of the jet.

Israel Shipyards Ltd. is Israel's shipbuilding firm, and it deals in ship construction and repairs (Sa'ar 4 and 4.5 missile boats). Israel Shipyards has built naval products both for Israel and for export. The company faced financial difficulties in the late 1980s, following the termination of all major naval production contracts, and the absence of new civilian construction activity. It nonetheless proceeded to develop the Shaldag attack craft, which it was hoped would improve its fortunes. The Israeli Navy, however, refused to buy the Shaldag without even testing it and continued to prefer the IAI-produced Super Dvora. In mid-1990, Chief-of-Staff Shomron promised to appoint a team to test the patrol boat, and in early 1991 it was tested, although the IDF still refused to purchase it. The U.S. Coast Guard, however, is considering buying 50 Shaldags to use in its war on drugs. Toward the close of the decade Israel Shipyards' financial situation stabilized thanks to extensive cost-cutting measures, as well as an infusion of much maintenance and overhaul work (including work for the U.S. Navy 6th Fleet).

Bet Shemesh Engines, devoted to developing, manufacturing, and repairing jet engines, originally manufactured and assembled Marbore VI turbojets for the Israeli Air Force's Tzukit version of the French-made Fouga Magister trainer, and later manufactured portions of the General Electric J79 engine-power, which powers the Israeli Kfir fighter. Bet Shemesh Engines is currently owned 58 percent by the Government, 40 percent by United Technologies, and 2 percent by the Education Fund. Between 1985 and 1987 the company had problems with Pratt & Whitney over the licensed-production of the PW 1120 engine destined for the now-defunct Lavi jet fighter project.

In the early 1980s, Bet Shemesh suffered heavy losses and the board of directors claimed that the government was not investing the promised funds to help the company expand its capacity to produce the PW 1120 engines. In January 1985, Pratt & Whitney acquired 40 percent control of the company (58 percent remained in the hands of the MOD, and 2 percent was owned by the late French industrialist J. Shidlovsky), but Bet Shemesh Engines still faced financial difficulties. Senior officials threatened to resign and place the company in receivership unless unions representing the 1,300 employees agreed to a plan to fire 400 to 500 workers. Bet Shemesh's losses reached $55 million by the end of 1985, and its cumulative debt reached $65 million in 1987.

Consequently, in early January 1987 the Israeli Government appointed a receiver to run the company (an arrangement similar to Chapter 11 in the United States). Following the cancellation of the Lavi project, Pratt & Whitney, which originally invested $10 million in the company, considered pulling out but ultimately decided to stay in. Since 1987, Bet Shemesh Engines' workforce, level of activity, and operating losses have decreased, but the company's future remains uncertain.

Public-Sector Corporations

This group of defense industries highlights a unique aspect of the Israeli economy in general: these are firms owned by the major trade union, Histadrut, and are controlled directly by Koor, the industrial holding company owned by Histadrut. Here one finds Soltam, Tadiran, and Telkoor.

Soltam is a weapons and ammunitions factory specializing in mortars and artillery weapons. A recent agreement between its two principal shareholders, the Zeldowitz family (which held 26 percent of the company's stocks) and Koor, has resulted in the transfer of Soltam to full Koor ownership. Soltam is one of the companies that suffered from the smaller defense budgets in the second half of the previous decade. Soltam had its best year in 1978 with exports of mortars, artillery weapons, and shells reaching $94 million (mainly to the Shah of Iran). Khomeini's rise to power reduced demand from the world market and increased competition created difficulties for the company, and while in the early 1980s it recovered somewhat, since 1984 there has been a drastic decrease in sales.

In 1987, Soltam's deficits increased due to a change in the IDF procurement policy. In an attempt to save the company massive cutbacks were proposed, which led to severe tensions between management and the nearly 2,400 workers. These labor disputes reached a peak in August 1987, and since then 1,800 employees have been fired. The most recent labor dispute broke out in late July 1990 following plans to fire a further 180 employees from the remaining 580. Nevertheless, in late 1990 Soltam had orders of $30 million, a large portion of which were already in the factory's stock, and this growth in orders may help the company reach operational balance.

Tadiran, traditionally Israel's largest producer of electronics, specializes in both civilian and military communications equipment. Tadiran deals in three areas of military production: communications, electronic warfare systems for the Air Force, Navy, and Intelligence Corps that are developed and produced in Tadiran's subsidiary Elisra, and electro-optical systems produced through El-Op. The civilian sector of Tadiran is comprised mainly of consumer electronics and telecommunications. As a result of defense budget cuts, Tadiran's defense section has been losing money, while the civilian sector—which comprises more than 50 percent of total activity—is registering hefty profits.

In the mid-1980s, Tadiran experienced financial difficulties in its defense sector due to a slowdown in its traditional export market, and cutbacks in orders from the Israeli Signal Corps. In 1988, Tadiran in conjunction with General Dynamics Electronics Division was selected to supply Single Channel Ground and Airborne Radio System (SINCGARS) equipment to the U.S. Army. The selection nonetheless entailed complications for Tadiran, as the company was required to make heavy outlays both in preparation for production in the United States and in anticipation of future contracts. Other Tadiran military projects include battle management simulators, work on Strategic Defense Initiative projects, and ground stations for UAVs.

Data on Tadiran from 1986 and 1991 show that the workforce has been cut from 13,000 to 6,500. Total sales registered for 1986 were $620 million, while projections for 1991 reach $700 million. The division between defense and civilian sales shows that while in 1986 more was directed to the defense market ($360 million v. $260 million), in 1991 expectations are that $380 million will be civilian and only $320 million defense-oriented. While traditionally the ratio of defense exports to sales to the Ministry of Defense stood at 50:50, projections for 1991 show that $200 million will be directed to export and only $120 million will be sold to the IDF, about a 60:40 split.

Another variant of the public sector corporations are those run by a kibbutz, a collective settlement; an example of this type of corporation is the Nezer-Sereni Metal Works, which produces vehicle chassis.

Private-Sector Corporations

This category includes privately owned firms that produce military materiel for the defense establishment. Examples include Elbit, Urdan, El-Op, and Rada. Funding for private sector corporations often comes from the Israeli and American stock market as well as from the large banks. Some of these firms are owned by Klal—an industrial conglomerate owned by Israeli banks (more than half of Urdan's stock, for example, is owned by Klal).

Elbit is Israel's largest computer systems house and exporter of computer-based products and systems; its shares are traded on the Tel Aviv Stock Exchange and over-the-counter in the United States. Elbit deals in airborne, ground, and naval systems, and advanced battlefield systems. For example, an innovative sensor for the detection of chemical warfare material produced by Elbit was used for the first time during the Persian Gulf War. Elbit also develops, manufactures, and markets a variety of civilian systems and products ranging from imaging radiometer systems to computer products and services.

Elbit is one of the few defense companies not to have had a crisis in the mid-1980s, mainly due to its high proportion of civilian sales. Elbit formulated three strategic goals: acquisition of companies that complement Elbit's activity in the military sector, such as the proposed takeover of El-Op, joint ventures with American and European companies, and investments in the civilian sector. Elbit's 1990 takeover of 70 percent of the stock of Elscint, a producer of medical equipment, was a major step in the direction of greater civilian production.

Data from the past 3 years illustrate Elbit's financial soundness. Total revenues for 1988 were $158 million with a backlog of orders of $316 million; sales outside Israel came to $98 million and domestic sales reached $60 million. Elbit recorded a record-high profit of $22 million for 1990, as compared to $13 million in 1989; moreover, Elbit's income from the civilian market made up 57 percent of the company's total income (as compared to 23 percent in 1989). Elbit derived 45 percent of its 1990 revenues from Elscint, and over 80 percent of the revenues came from export and international sales. Elbit is currently taking steps to further strengthen its position in the U.S. market.

Urdan, comprised of several autonomous operations, produces items principally in metal and steel: armored steel castings, tank and armored vehicles suspension parts, tank upgrading kits, mine clearing systems, ammunition trailers, and various spare parts. Urdan suffered heavy losses in the past 4 years, about $7.5 million in 1990 alone; a large portion of the losses are related to the shutdown of its American subsidiary Lebanon Steel Corp. in September 1990. Moreover, Urdan sells mainly to the Israeli MOD and the U.S. Army, but the MOD has not committed itself beyond April 1992 and hasn't specified a minimum of Merkava tanks that it will buy from Urdan. Long-term sales contracts with the U.S. Army end in late 1991, and additional contracts are uncertain at this point. The chassis that Urdan produced for the Patriot missile were sold at what turned out to be a significant loss; while a technical success, it was a financial failure.

Urdan, one of the defense industries most in need of a transition to civilian markets, has few resources with which to do so. Urdan will undoubtedly find it difficult both to expand its clientele for existing products and to find the resources to develop products with which to enter new civilian markets.

El-Op, half owned by Tadiran, specializes in optical products, night vision technology, and laser technology (including tank fire control systems, thermal imaging and image intensification sights and systems, aerial and marine systems, and sights and optomechanical products). One of the smaller defense firms, with a total of 952 employees as of early 1991, El-Op's sales from 1986 to 1990 have been on the rise, from a recorded $83 million in 1986 to $129 million in 1990. The proportion of export versus local sales has changed quite significantly over the past 5 years: while in 1986 $37 million was directed to export and $47 million was local, in 1990 over $82 million went to export and $40 million was local.

Rada focuses on air force ground support equipment, avionics, computers constructed to military specifications, automatic test equipment, and computerized control systems. Rada is one of the few industries to gain from the worldwide defense budget cuts, as it produces test and maintenance equipment; Rada participates in avionics upgrades in most of the avionics industries in the world.

Another private defense industry that has recently been successful is Eagle Military Gear Overseas. This company produces and markets different types of armored vests, battle vests for infantry units, armored corps, demolition squads, medical corps, naval commandos, etc., nuclear biological and chemical warfare (NBC) equipment, and various accessories. For the 6 months preceding November 1990, Eagle recorded earnings of just under $1 million, as opposed to losses of roughly $1 million for the 14-month period ending on May 31, 1990. Eagle presently has orders that reach roughly $80 million and has more than 500 employees in its 1 U.S. and 2 Israeli plants Following the Gulf War, there has been increased interest in Eagle's NBC protective gear in both the United States and Israel.

Thus, the largest Israeli defense firms (IAI, IMI, and Rafael) are still closely tied to the government. The privately owned defense industries are much smaller, although they are relatively successful despite the constraints and competition posed by the larger state-owned companies.

The past 5 years have been characterized by defense budget cuts and a decrease in MOD orders from local defense industries, which have resulted in serious economic difficulties for most of these companies. While 5 years ago the defense firms together employed a total of 60,000, today less than 45,000 remain. These difficulties have pushed the defense industries toward increased exports and redirection of production to the civilian market. Not all industries have been able to deal with the transition successfully, and in addition to personnel cutbacks, a number of plants have been forced to shut down. Paradoxically, those companies that needed most to shift to civilian and export markets are also those with the fewest resources with which to do so—for example, Soltam and Urdan.

Other companies, such as IAI and Elbit, have found the transition much easier. In spite of the difficulties, on the whole the defense industries have adapted themselves to changing realities. Export figures, for example, show that while in 1984, 70 percent of defense industry products were sold to the IDF and only 30 percent directed to export, toward the close of the decade the situation was reversed.

DOMESTIC AND FOREIGN SALES

Domestic arms requirements provided the original rationale for development of an indigenous defense industry in Israel. Consequently, the industry's products and output have traditionally been oriented toward the IDF. Senior IDF officials have been reluctant to rely on domestic procurement, especially for those products that could be obtained elsewhere either sooner or with more certainty regarding performance and ultimate cost. But their reluctance was frequently overruled by a powerful combination of high-level political support for the development of an indigenous defense industry, and foreign restrictions on arms sales to Israel. Furthermore, over time some of the military's opposition to domestic procurement has also dissipated, due to several impressive indigenous weapons developments.

Thus, after a modest beginning in the 1950s, the industry has increasingly become the most important source of defense products and services for the IDF. Early on, the indigenous industry assumed most maintenance and retrofit services for the IDF and embarked on the domestic production of ammunition, light arms, and automotive parts as well. These were initially supplemented with World War II British and Korean War-era U.S. surpluses as well as new French materiel. Gradually, the Israeli industry also made inroads into additional and more sophisticated areas. It has embarked on licensed production and ultimately development as well, for the IDF, of communications gear, electronic warfare, radars, avionics, missiles and rockets, as well as self-propelled artillery, mortars, tanks, jet trainers and fighters, and naval craft. Its products have entered the IDF ranks in increasing numbers in the 1970s and 1980s, side by side with new U.S.-made arms that began to flow to Israel in the mid-1960s. As a result of the development of the indigenous defense industry and the severance of defense ties with France, Israel attained in the post-1967 era an extremely high degree of self-sufficiency in certain key areas of military procurement.

Most products of the Israeli defense industry originally developed for domestic consumption are also sold abroad, the two principle exceptions being Merkava tanks (as distinguished from certain tank components) for which there have been no foreign buyers, and certain sensitive systems that are often exported in somewhat downgraded versions. An important export item of the industry has been the Gabriel surface-to-surface missile, several models of which have been sold abroad. Other Israeli developed products that have met with significant export success include several types of missiles, sophisticated tank and artillery ammunition, fire control, radio communication, and electronic warfare systems, mini-remotely piloted vehicles (RPVs), and light arms (see table 5-4).

The most important foreign markets for the Israeli defense industry have traditionally been in Latin America and Southeast Asia. They were partially displaced by Iran (under the Shah), South Africa, and certain West European customers in the 1970s and early 1980s. This pattern changed course again in the 1980s with the loss of the Iranian market (in the early 1980s), the imposition of a ban on new arms sales to South Africa (since 1987), and the tightening defense cooperation between Israel and the United States. Consequently, in the latter part of the 1980s the United States emerged as the single most important foreign customer of the Israeli defense industry.

THE U.S. CONNECTION

The relationship between the Israeli and U.S. defense industries in the 1980s (especially the latter half of the decade) was characterized by increased cooperation on common projects (U.S. firms teamed with Israeli firms or used them as subcontractors) and by growing defense exports from Israel to the United States. Since February 1987, Israel has been permitted to compete for Pentagon contracts as a major U.S. non-NATO ally; moreover, Israeli companies have entered the American market also through direct contacts with branches of the U.S. Armed Forces.

Israel has benefited from the dollars or barter products obtained in return for defense exports, as

Table 5-4—Selected Arms Orders, Deliveries and Licensed Production of Israeli Weapon Systems, 1986-88

Arms transfers from Israel

Recipient	Number ordered	Weapon name	Type	Year ordered	Year delivered	Number
United States	37	Kfir-C1	Fighter	1984-86	1985-87	25
	12	Popeye	Antiship missile	1986	1987	6
	114	Have Nap	Antitank guided missile	1986-88	1987-88	14
Argentina	1	B-707-320C	Transport	1985	1987	1
	120	Shafir	Air-to-air missile	1986	1988	60
Chile	13	Kfir-C7	Fighter	1988		
	30	M-4 Sherman	Main battle tank	1987	1987	30
Colombia	14	Kfir-C2	Fighter	1981		
Ecuador	12	Kfir-C7	Fighter	1986	1986-87	12
	2	Barak launcher	Ship-to-air missile launcher	1984		
	16	Barak	Ship-to-air/surface-to-air/ point defense missile	1984		
	96	Shafrir-2	Air-to-air missile	1986	1987	96
Paraguay		IAI-201 Arava	Transport	1985		
Lebanon	36	BTR-60P	Armored personnel carrier	1987	1987	18
	18	M-1944 100mm	Towed gun	1987	1987	18
	18	T-54	Main battle tank	1987	1987	18
Liberia	3	IAI-201 Arava	Transport	1984	1985	3
Cameroon	4	IAI-202 Arava	Transport	1985		
	10	Kfir-C7	Fighter	1985		
Sri Lanka	18	Dvora Class	Fast attack craft	1985-87	1987-88	12
China		Mapats	Portable antitank missile	1986		
Thailand	12	Bariel-2	Ship-to-ship missile	1987	1988	12
Fiji	3	IAI-202 Arava	Transport	1986		
Papua New Guinea	3	IAI-201 Arava	Transport	1984	1984 1985	1 2

Licensed production of Israeli weapon systems

Licensee	Number ordered	Weapon name	Type	Year ordered	Year delivered	Number
United States		EL/2106	Point defense radar	1983		
		Popeye	Antiship missile	1987		
South Africa	96	Gabriel-2	Ship-to-ship/surface-to-ship missile	1984	1986-88	36
	12	Reshef Class	Fast attack craft	1974	1978-88	9
Taiwan		Gabriel	Ship-to-ship/surface-to-ship missile launcher	1978	1980-88	48
		Gabriel-2	Ship-to-ship/surface-to-ship missile	1978	1980-88	375

NOTE: Blank spaces denote information not publicly known.

SOURCES: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1986 through 1989, *World Armaments and Disarmament.*

well as from the closeness of the military relationship (Israel became a major partner in the Strategic Defense Initiative). The United States has benefited from Israel's ability to fill essential technological gaps at short notice, and to provide off-the-shelf weapons, as well as from the fact that IDF weapons systems are battle proven. According to Brig. Gen. (ret.) Uzi Eilam, current head of the Israeli MOD's Weapons and Infrastructure Development Authority, a factor that pushed Israel to cooperate was the growing cost and complexity of technologically sophisticated weapons systems, epitomized by cancellation of the Lavi fighter. A drawback of Israel's penetration into the U.S. market is that it is usually in partnership with U.S. companies, with production usually carried out in the United States; thus, while these projects are lucrative to the Israeli companies, they do not necessarily create more jobs in Israel.

The formal aspect of the U.S.-Israeli cooperation in defense production finds expression in a series of Memoranda of Agreement and Memoranda of Understanding signed by the governments of the two countries. These MOAs and MOUs provide the legal authority for U.S.-Israeli cooperation in R&D, for Israeli companies' attempts to secure U.S. defense contracts, and for Israeli participation in large-scale defense projects, most notably SDI. The following is a brief review of the important MOUs and MOAs in cooperative defense research and production.

U.S.-Israeli military technological cooperation began in 1971 with an agreement between the two countries for the United States to provide technical information and assistance for arms production; this did not lead to agreements for coproduction. In fact, under the Carter Administration, Israel regularly received compensation for having been denied coproduction agreements. Cooperation with Israel was opposed in Congress because of concern that the United States might be aiding potential competitors to U.S. industries. The Reagan Administration was much less reluctant in this regard, and the most significant defense MOAs and MOUs were signed during the Reagan Presidency.

The first significant defense MOA between the United States and Israel was signed in 1979, during the Carter Administration, and may be seen as a reward to Israel for having concluded a peace treaty with Egypt. As mentioned above, this MOA enabled Israeli defense firms to participate in U.S. Government contract bidding, and also provided for cooperation in R&D. But, unlike the MOUs signed between the United States and NATO countries, the U.S.-Israeli MOA was not comprehensive. Only a specified number of defense items (initially 500) were not to be subject to Buy America restrictions. Moreover, actual implementation of the 1979 MOA was problematic in terms of the domestic sensitivities to non-American procurement.

In early 1984, this MOA on security matters was renewed and expanded. It aimed to facilitate Israeli military exports to the United States, allowed for freer Israeli access to the U.S. market by increasing the number of categories open for Israeli bids, and prevented U.S. officials from vetoing deals with Israel once the bidding process has been completed, if an Israeli firm had been identified as the lowest bidder. Israeli sales to the U.S. Defense Department rose significantly under the new MOA, and an independent defense industrial relationship was established between the two countries.

A special MOA was signed in May 1986 to provide a comprehensive basis for participation of laboratories, research centers, defense industries, and other entities in Israel in SDI research. This MOA was followed by several more, as well as actual contracts involving more than $200 million (programs include the Arrow ballistic missile defense system, the Israeli Test Bed, and work on the architecture of such a system). In February 1987 Israel was declared a major non-NATO ally, and in December of that year an MOU was signed that covered R&D, logistics support, and additional SDI work, and brought Israel's status on cooperation in line with NATO countries. It generally enabled Israel to compete on an equal footing with U.S. and NATO companies for U.S. contracts, gave Israel more latitude to sell weapons to the United States, and elevated Israel to a trade status previously granted to only two other non-NATO allies—Sweden and Australia.

Beyond Israel's participation in SDI, which has primarily been between IAI and the Strategic Defense Initiative Organization, Israel's most intimate relationship with the U.S. Armed Services has been cooperation on Navy and Marine Corps projects. This includes the leasing of two Kfir (F-21) squadrons for aggressor squadrons, the sale of mini-RPVs and mobile bridging equipment, IMI's Portable Mine Neutralization System (POMINS) II, and laser range finders for U.S. Marine Corps AH-1W Cobra helicopters (El Op, IAI with Kollsman). Israel's relationship with the U.S. Army has also been close, and has consisted of sales of mortars, radio communication (including SINCGARS), tank launch bridging equipment, and a plow bulldozer system for BMY's Counter Obstacle Vehicle. The least amount of cooperation has been with the U.S. Air Force. To date it includes only the Have-Nap (AGM 132) air-to-ground missile deal with the Strategic Air Command (Rafael with Martin Marietta), although the Tactical Air Command is also currently evaluating the procurement of the same missile.

Recent cooperation between U.S. and Israeli defense firms includes a $200 million contract for IAI to improve F-5 jets produced by Northrop, the Adams Mobile Defense System jointly produced by General Dynamics and Rafael, and data-transfer equipment for F-16 jets that Rada Electronics Industries produced for General Dynamics. The U.S. Congress recently awarded $53 million for the continued development and purchase of IAI laser systems for U.S. Marine Corps' super-Cobra helicopter (for 1991). A subsidiary of Eagle in the United States has received an order for protective coveralls and tents (against nuclear biological and chemical warfare) for $14 million.

Elbit has received a $10 million order from General Dynamics for the supply of avionics systems until 1992; this deal was concluded as part of General Dynamics' commitment to offsets in Israel in the framework of the agreement to supply F-16s to the Israeli Air Force. Rafael and Martin Marietta are jointly contenders for a large contract for reactive armor for the new Bradley Armored Fighting Vehicles. If Rafael and Martin Marietta win, 50 percent of production will be carried out in Israel. Finally, IAI, in a joint venture with TRW, is conducting test flights of the future unmanned aerial vehicle (UAV) that it wants to sell to all branches of the U.S. military. Following the successful employment of IAI's Pioneer UAV in the Gulf War aboard U.S. Navy battleships, procurement of additional Pioneer mini-RPVs is being seriously evaluated by the U.S. Navy.

Thus, the main features of the cooperation between U.S. and Israeli defense industries are the following:

1. Outright procurement from Israeli defense industries has risen over the years; yet in most cases it is done in collaboration with U.S. companies, with the actual production carried out in the United States.
2. A significant amount of activity has resulted either from direct or indirect offset agreements incorporated in the major IDF contracts with U.S. companies.
3. To date there have been relatively few joint ventures in R&D, although there are early signs that joint activity in this realm is on the rise.

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Japanese Defense Industrial Policy and U.S.-Japan Security Relations

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Chapter 6

Japanese Defense Industrial Policy and U.S.-Japan Security Relations

INTRODUCTION AND OVERVIEW

Over the past 30 years the U.S.-Japan bilateral security relationship has been directed toward the potential threat posed by the Soviet Union and other Communist powers in East Asia. Now that the Cold War has ended, there are strong political pressures on Japan, both internal and external, to reduce defense spending. However, many Japan Defense Agency (JDA) officials believe that qualitative improvements have offset quantitative reductions in Soviet forces in the region. Indeed, some believe that greater uncertainties in international relations argue for retention of increased self-defense capabilities. Others argue, instead, that Soviet aggressiveness is reduced and that Japan must moderate its defense budgets accordingly. These differences have led to an intense policy debate within Japan over the appropriate types and levels of defense spending.

A number of factors complicate long-term planning and create doubts about the future of the bilateral security relationship with the United States. Perhaps most important, the United States is sending mixed signals to Japan regarding its intentions in the region. On one hand, the United States continues to pressure Japan to assume more of the cost of its own defense. Many Japanese officials view this as an indication that the United States may not remain fully committed to the bilateral security treaty,[1] producing uncertainty for Japan and justifying additional defense spending. Japan's reluctance to provide support for the United States in the Persian Gulf War has highlighted what many in the United States still feel is a free ride on defense for Japan. On the other hand, when Japan *does* slate money for defense, this is sometimes criticized in the United States, in part because it is viewed as being driven by economic factors, not genuine security concerns. This claim was a prominent element of the Fighter Support Experimental (FSX) debate and remains a critical consideration in discussions of cooperative projects with Japan.

The increased emphasis given economic issues by the United States is exerting considerable stress and may eventually undermine the security relationship with Japan. Previous administrations had pursued economic and defense issues in isolation, in order to ensure that economic frictions did not harm security cooperation. With the Bush Administration, such a separation no longer appears possible. Indeed, security increasingly is defined in economic terms by the United States, leading to apprehension in Japan that the United States will reduce opportunities for cooperative programs and that existing efforts, notably the FSX, will be delayed.

Collaboration in military technology with Japan has been a one-way street for decades. Massive technology transfers have taken place from the United States to Japan under existing programs (see figure 6-1). Licensed production of a variety of types of U.S. military aircraft has contributed to the development of a core of Japanese companies skilled in diverse aspects of aircraft production.[2] These programs have also stimulated critical industries such as electronics and materials through generous technology transfers.

In the past, U.S. policymakers have recognized the economic implications of these transfers but felt they were justified because of their military benefits. Recently, however, the economic disadvantages of those programs have been viewed in a more critical light. For example, the FSX fighter codevelopment program remains controversial. The failure to produce a two-way technology flow has led to a broad questioning of the value of these programs to the United States. More importantly, cooperative defense production programs, coupled with indigenous efforts, have transferred to Japan a high degree of self-sufficiency in defense production.

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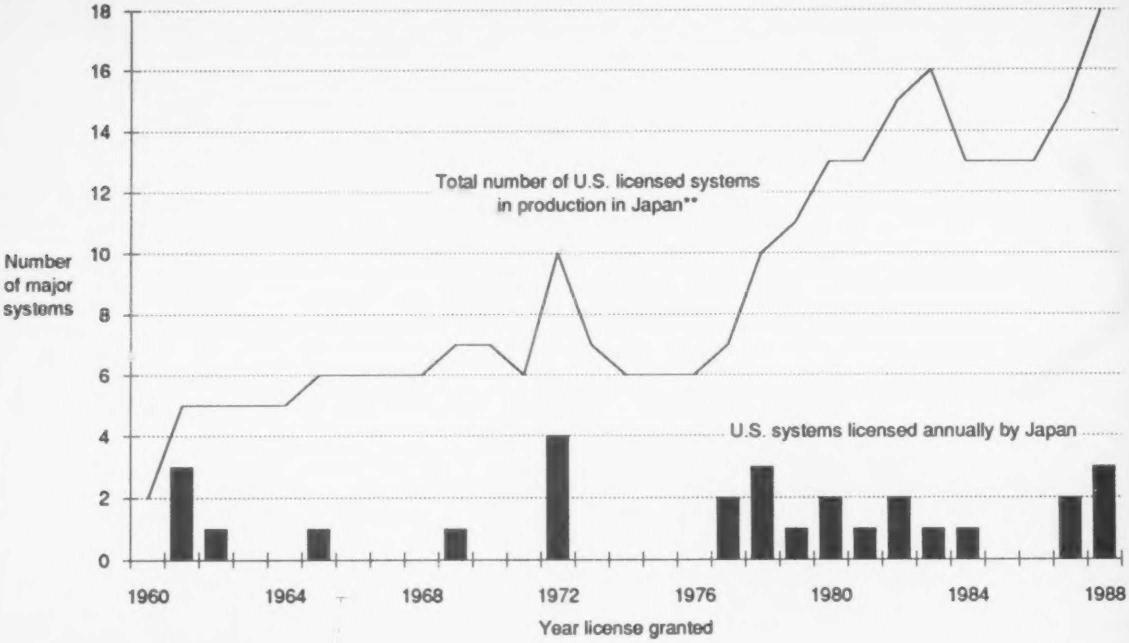
[1] The Treaty of Mutual Cooperation and Security of 1960. A second fundamental document enabling U.S.-Japan defense cooperation is the Mutual Defense Assistance Agreement (MDAA) of 1954. For the purposes of this discussion, references to the security treaty will mean either the 1960 treaty, the MDAA, or both.

[2] Aircraft produced in Japan include the Bell UH-1H Heuy helicopter, the Bell AH-1S Cobra helicopter, the Lockheed P-3C Orion patrol airplane, the Boeing 107 Model II helicopter, the Boeing CH-47 Chinook helicopter, the McDonnell Douglas Model 500D helicopter, the McDonnell Douglas F-4E Phantom jet fighter, the McDonnell Douglas F-15J and F-15DJ Eagle jetfighter, and the Sikorsky S-61, S-61A, and S-61B helicopters.

Figure 6-1—Estimated Japanese Licensed Production of U.S. Major Conventional Weapon Systems,* 1960-88



*Japan license-produced major systems only from the U.S.
**Estimates based on the assumption that an average system is produced under license for 12 years.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks 1970 through 1990, *World Armaments and Disarmament.*

Japanese defense planners argue that the momentum achieved over the past decade must be continued in order to assure minimum self-defense capabilities. Japanese industry has invested heavily in defense production and would like present funding levels continued to allow sufficient time to restructure in the event that greater spending becomes politically unsupportable.

The outcome of these deliberations will affect Japanese security policies for at least the next decade. The defense buildup that has taken place over the past 15 years resulted from a carefully crafted set of compromises. Reversing or modifying those compromises could require an equally broad political consensus that will influence defense budgets in the future. Abrupt fluctuations in Japan's defense budget, either toward expanded or reduced funding, are unlikely given the domestic political process.

Several large-scale procurement projects will be affected by this debate, including full-scale production of the FSX fighter aircraft, licensed production of the Multiple Launch Rocket System (MLRS), acquisition of Airborne Warning and Command Systems (AWACS), over-the-horizon (OTH) radar, and mid-air refueling tankers. Domestic development programs could also be affected, although industry and JDA are both lobbying for higher R&D spending. Some companies have already begun adjusting their production strategies. The domestic Japanese defense market could be restructured significantly in the coming decade.

Japanese industry lacks incentives to share technology with the United States in collaborative defense programs. For Japanese firms, technology is viewed as a precious commodity that should not be licensed indiscriminately but should be accessed and absorbed whenever possible. Japanese industry views the United States as the competition, so the motivation to cooperate by transferring technology reciprocally is limited. American interest in collaborative projects is also uncertain; the continuing difficulties associated with the FSX project have generated resentment in both countries.

Photo credit: U.S. Department of Defense

Licensed production of the F-4EJ, which resembles these U.S. Air Force F-4Gs, began in the early 1970s and was an important source of technical know-how for the developing Japanese military aerospace industry. Other U.S. license production arrangements for fighter aircraft in Japan include the F-104 Starfighter and the F-15J.

Photo credit: U.S. Department of Defense

The Boeing E-3 Airborne Warning and Command System (AWACS), currently the most advanced early warning system of its kind, is one of several procurement projects that may be affected by current debates in Japan over the future of defense collaboration with the United States.

The FSX experience is pushing industry and government in Japan toward even greater reliance on domestic capabilities. Several independent R&D projects have been launched, aimed ultimately at self-sufficiency in complete systems and toward enhancing negotiating leverage vis-à-vis the United States and other potential foreign partners. These include a medium-range, surface-to-air missile to replace the U.S.-designed Hawk and computers to replace IBM computers in the F-15 fire control system.

Japan continues to prohibit the export of complete weapon systems. This policy is likely to remain intact for the foreseeable future, because it involves fundamental foreign policy considerations, not simply economic factors. However, it is likely that Japanese firms will exert increasing influence on defense policies in the future because defense development will rely increasingly on dual-use technologies whose control by government policies remains unclear.

Despite pressure to liberalize defense exports from some defense producers, the government of Japan enforces a prohibition against exporting complete defense systems. Component exports are another matter, especially for components embodying dual-use technology. Even though constraints on the export of complete weapon systems might remain in effect for decades to come, Japanese firms could still build a sizable defense-related business through component exports. This could take place without a change in current government policies.

THE COLD WAR IN ASIA AND JAPANESE SECURITY DEBATES

A framework of policies has resulted in 15 years of steady but limited growth in Japan's defense capabilities. These policies are now coming under scrutiny as Japan debates whether the security environment for the coming decades will grow more or less hostile.

A Brief Review of Japan's Defense Policy

In *Arming Our Allies*, OTA published a detailed analysis of Japanese defense policy. The principal elements of that policy are summarized below.[3]

- **Article 9 of the Constitution.** The so-called "no war clause" that renounces the use of force to settle international disputes. Japanese pacifism and Article 9 have reinforced one another since the end of World War II.

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[3] See U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technologies*, OTA-ISC-449 (Washington, DC: U.S. Government Printing Office, May 1990), ch. 4.

- **Reliance on the United States for defense.** The laws that govern Japan's defense establishment prohibit the country from entering into collective security agreements. The bilateral security treaty with the United States is the only defense or security agreement entered into by the government since the end of World War II. Although calls have been issued to reevaluate the treaty,[4] it still serves as the basis for the bilateral security relationship. Forty-five years of practice have led the Japanese defense community to rely heavily on the United States for planning, equipment, technology, and other aspects of its overall defense structure.
- **Restrictions on the use of military forces.** These include legislative prohibitions, constitutional provisions and/or cabinet statements prohibiting overseas troop deployments,[5] limiting weapon procurements to defensive systems (as opposed to offensive weapons), and banning a military draft.
- **The nuclear prohibitions.** Japan has opposed the possession, introduction, or manufacture of nuclear weapons. This policy is supported both by legislation (e.g., in the Atomic Energy Law) and Cabinet policy statements. Equally strict prohibitions exist for the manufacture of biological and chemical weapons.
- **Weapons export limitations.** As a matter of policy Japan does not export weapons, military technology, or weapons manufacturing capabilities to other countries. However, because the Japanese definition of weapons is narrowly drawn, the policy has been weakened by the expanding use of dual-use technology in weapon production. Nevertheless, this policy has effectively curtailed exports of complete weapon systems and remains a fundamental element of Japan's security posture.
- **Peaceful uses of space.** Japanese policies call for the peaceful use of space. Its participation in Strategic Defense Initiative research is viewed as consistent with this position.
- **Quantitative spending limitations.** In 1976, the Cabinet instituted a spending cap on total Japanese defense spending by stipulating that the defense budget could not exceed 1 percent of that fiscal year's estimated gross national product (GNP). This provision was eliminated in 1986, and was replaced by quantitative acquisition levels stipulated in 5-year defense procurement plans. In practice, however, spending is still limited to about 1 percent of GNP. Because of intense policy debates now under way in Japan, it is possible that explicit spending restrictions could be put into effect again.

Japan's defense policymaking has also been affected by government policies emphasizing economic development over rearmament, and by differing views of the external threat throughout the postwar period. At the end of World War II, Japan's economy was devastated, and economic recovery was the highest priority. U.S. defense collaboration policies with Japan sought in part to further this economic development by contributing to indigenous defense production capabilities through licensing programs.[6]

The 1976 National Defense Plan Outline established a common rationale for defense procurement in the subsequent decade and, for all practical purposes, issues of threat perceptions were set aside. Japanese views toward the Soviets hardened in the early 1980s, however, particularly with the invasion of Afghanistan and the Soviet downing of civilian Korean Airlines flight 007 in 1983. However, with the dramatic changes that have taken place globally, especially in Eastern Europe, these attitudes towards the Soviets are now being reappraised.

The Japan Defense Agency insists that the Self-Defense Forces must maintain their current capabilities in the event that changes in the Soviet Union are not permanent. Defense officials note that while Soviet force levels might decline in the Asian region, the quality of those forces remains high and continues to pose a military threat to Japan. They add further that the present levels of Japanese defense capabilities were outlined in 1976, a period during which the government had officially anticipated a continuation of detente between the superpowers,[7] and thus more, not less, defense expenditure is required.

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[4] See, for example, Keiichi Kawanashi, "Time To Re-Examine the Security Treaty," *Japan Economic Journal*, Apr. 21, 1990, p. 9; Chikayo Mogi, "Growing Doubts Over Security Treaty With U.S.," Kyodo News Service, cited in Foreign Broadcast Information Service, *Daily Report: East Asia*, FBIS-EAS-90-118, June 19, 1990, p. 1; "Rethinking the Japan-U.S. Alliance," *Japan Echo*, vol. 17, No. 1, 1990.

[5] The Kaifu Government withdrew legislation introduced in late 1990 to allow overseas deployment of noncombatants from the Self-Defense Forces in peacekeeping operations organized and sanctioned by the United Nations.

[6] U.S. Congress, Office of Technology Assessment, op. cit., footnote 3, pp. 61-62.

JDA and other parts of the government may also wish to hedge against planned U.S. troop reductions in Japan in case they lead to a long-term trend toward total withdrawal from the country. In February 1990, Secretary of Defense Richard B. Cheney reassured Japan of the U.S. commitment to the country and the region as a whole despite plans to withdraw 10 percent of the U.S. military forces from Asia.[8] In either case, continued U.S. retraction would force Japan to assume a greater share of its defense requirements.

These views are not held uniformly throughout the Japanese Government. In mid-1990 Prime Minister Toshiki Kaifu took the position that the Soviet threat facing Japan no longer warranted the spending increases of the past 15 years (see table 6-1). He instructed JDA to take "changes in the international situation" into account in preparing its 1991 budget. Consequently, Japan's defense spending in fiscal year 1991 will rise only 5.5 percent.[9] While this amount was still high, it represented a symbolic victory for the Kaifu Government, as JDA had sought a 6- to 7-percent increase. Furthermore, the government decided not to initiate major new procurement programs for at least another budget cycle.

The Defense Budget Outlook

The 1991 budget initiates a new 5-year defense procurement plan that will increase defense spending in real terms by an average of 3 percent annually for the 5-year period. Despite the insistence that front-line equipment will be deemphasized in the coming plan, a number of new systems are under consideration. These include Boeing E-3 AWACS, mid-air refueling tankers, additional Aegis systems, and MLRS, probably under a licensed production arrangement involving the U.S. firm LTV and Nissan Motor Co. It is possible that a production decision on the FSX fighter aircraft will also be reached. Two important coproduction programs will end during the 5-year period: the McDonnell Douglas/Mitsubishi Heavy Industries F-15J program, and the Lockheed/Kawasaki Heavy Industries P-3C program. The end of both programs will have a significant effect on domestic companies.[10]

Table 6-1—Japan's Defense Budget, Fiscal Years 1955-90 (billions in current yen)

	Budget (Yen, billions)	Percent change from previous year	Percent of GNP
1955	134.9	–3.3	1.78
1965	301.4	9.6	1.07
1975	1,327.3	21.4	0.84
1980	2,230.2	6.5	0.90
1981	2,400.0	7.6	0.91
1982	2,586.1	7.8	0.93
1983	2,754.2	6.5	0.98
1984	2,934.7	6.6	0.99
1985	3,137.2	6.9	0.99
1986	3,343.6	6.6	0.99
1987	3,517.4	5.2	1.00
1988	3,700.3	5.2	1.01
1989	3,919.8	5.9	1.06
1990	4,159.0	6.1	0.99
1991[a]	4,402.3	5.5	0.99

[a] Budget request submitted to Ministry of Finance by Japan Defense Agency, pending Cabinet approval.

SOURCE: Japan Defense Agency, *Defense of Japan* (various editions).

Planning is further complicated by the continued sensitivity surrounding defense discussions, particularly with respect to the United States and the U.S. Congress. The negative publicity and arduous negotiations surrounding the FSX project caused Japanese government and business interests to feel that the U.S. Government dealt poorly with Japan by insisting on revisions in the agreement reached by the Reagan Administration. For Japan, the FSX was a fait accompli that should not have been re-

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[7] K. Masuoka, " 'Heiji Taisei' Iko e no Shomondai" ("Various Issues Related to the Transition to a 'Peacetime Posture' "), *Gunji Kenkyu (Japan Military Review)*, September 1990, vol. 25, No. 9, pp. 20-40.

[8] A 10-percent reduction in forces would amount to 12,000 troops. Of these, 5,000 to 6,000 are expected to be withdrawn from Japan, leaving approximately 50,000 U.S. servicemen in the country. The strategy behind these plans is outlined in U.S. Department of Defense, Office of the Secretary of Defense, "A Strategic Framework for the Asian Pacific Rim: Looking Beyond the 21st Century," 1990. Secretary Cheney's speech to the Japan National Press Club of Feb. 23, 1990, can be found in Hon. Richard B. Cheney, "To Remain in Asia," *Speaking of Japan*, vol. 11, No. 114, June 1990, pp. 1-8.

[9] Barbara Wanner, "Growth in Defense Spending Trimmed," *JEI Report*, No. 30B, Aug. 3, 1990, p. 5; "Tokyo Slows Down Defense Buildup Amid Global Changes," *JEI Report*, No. 1B, Jan. 11, 1991, pp. 8-11.

[10] Budget drafters could maintain current spending levels by stretching payments for major systems over longer periods than is now common. Typically, JDA pays for a system over a 4-year period. That period could be extended to 5 or 6 years in order to keep current outlays under control. This would generate huge future obligations, however, which would strain future budgets.

Photo credit: U.S. Department of Defense

The F-15E is claimed to be the world's preeminent fighter currently in production. The McDonnell Douglas/Mitsubishi F-15J and F-15DJ program, which began in 1980, is slated to end during the 1991-96 Japanese defense procurement plan when FSX production is supposed to begin.

examined. Congress' response to the FSX case was viewed as protectionist and at times motivated by racial fears or prejudices.

At the core of the defense budget debate is a reevaluation of the U.S.-Japan security relationship. The reduced threat now posed by the Soviets invites policymakers to reexamine the bilateral security treaty and the security relationship it represents. Some critics have called for the abolition of the mutual security treaty while others have urged a greater focus on its economic security considerations. (Article 2 of the treaty in fact states that its purpose is to promote the economic well-being of both signatories.) Furthermore, a wide range of regional security concerns remain that could provide valid reasons for continuing without change the present security relationship.

While the Japanese Government remains officially confident of the ability of the United States to extend its military protection to Japan, questions arise over the credibility of the U.S. deterrent in light of its economic problems.[11] The U.S. Government continues to call for JDA to assume greater defense responsibilities (in the Persian Gulf War, for example) and to assume vacancies left by U.S. forces in Japan. To some Japanese defense officials, both of these trends justify higher defense spending and also cast doubt on the role of the bilateral security treaty.

The United States has announced selective troop reductions, but has reiterated its commitment to Japan in particular and to Asia as a whole. The United States remains aware of its role as the honest broker in the region and that significantly expanded Japanese defense capabilities would be viewed as a threat by other nations in the Western Pacific.

THE MARKET FOR DEFENSE EQUIPMENT IN JAPAN

The uncertainties of Japan's defense policy and changes in its defense market will affect both domestic producers and the marketing strategies of U.S. firms. Orders from the previous 5-year program should sustain business for most major Japanese defense contractors for several years. For example, commercial and defense orders for Ishikawajima-Harima Heavy Industries, Ltd. (IHI) engines contributed in fiscal 1989 to a 10-percent growth in engine order backlogs. Fuji Heavy Industries (FHI) and Kawaski Heavy Industries (KHI) have enjoyed brisk business due largely to their defense activities.

Maintenance and upgrade programs, such as those for the F-15J, are likely to keep many companies busy, especially electronics firms as they are tapped to provide new mission computers, radars, and software packages. If the F-4EJ-Kai upgrade is any indication, the electronic brains of the F-15Js will be reconstituted primarily with Japanese domestic components.[12]

Upgrade work is not sufficient to sustain other parts of the defense industries, however. JDA does not plan to pursue domestic development of a replacement aircraft for the indigenously produced T-2 trainer, manufactured by MHI and IHI.[13] Several companies involved in aircraft production, including MHI, could suffer if the FSX fighter does not move into full-scale production. New programs mentioned above—including mid-air refueling tankers, over-the-horizon radar, MLRS and others—are on hold for at least a year.

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[11] Japan Defense Agency, *Defense of Japan 1988* (Tokyo: Japan Times Co., Ltd., 1988), pp. 66-67, and *Defense of Japan 1989* (Tokyo: Japan Times Co., Ltd., 1989), pp. 77-78.

[12] One of the motivations for using Japanese parts in the F-4EJ Kai is to avoid disputes with the United States over technology flowback. Modifying existing F-4s would allow the U.S. Government to claim cost-free flowback under existing Memoranda of Understanding. Replacing U.S. components entirely with Japanese components sidesteps that issue, since no modifications are made.

[13] Michael Green, "Japan May Not Develop Trainers," *Defense News*, vol. 5, No. 17, Apr. 23, 1990, p. 1. The T-4 is a brandnew aircraft, however, that will operate for at least another 10 to 15 years. Replacement is not necessarily an urgent issue. There also is sufficient time for the government to change its inclinations on a successor aircraft. A new codevelopment program is not entirely out of the question.

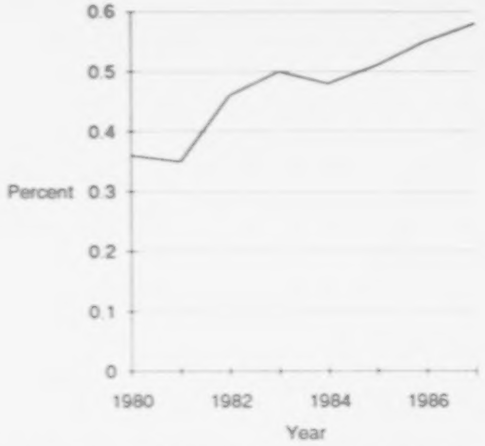
Although most Japanese firms do not depend heavily on defense sales, some firms have. Over the past decade, defense production has become somewhat more important in the Japanese economy (see figure 6-2). KHI stands out as an example, where orders from JDA have accounted for approximately 21 percent of KHI's total sales (see table 2-1 in ch. 2). Reduced defense orders, then, could adversely affect its business, particularly in key areas such as aircraft production. The same is true, to varying degrees, for other companies such as MHI, FHI, and IHI.

The most important source of uncertainty over new business is that the government has decided against initiating new procurement programs of front line equipment in fiscal year 1991 (Apr. 1, 1991 through Mar. 31, 1992). Firms are concerned that a 1-year hiatus in new programs could lead to additional delays, which complicates short-term planning and may lead companies to change their long-term strategies about the mix of commercial and military business.[14]

Some firms have already responded. MHI has announced plans to deemphasize defense sales in favor of commercial products, anticipating a decline in its defense sales from a high of 25 percent of total sales in recent years to 15 to 17 percent of total sales 2 to 3 years from now.[15] It also will shift much of its long-term defense focus to communications and R&D, positioning itself to take advantage of possible future orders. KHI, which was counting on JDA orders to provide as much as 70 percent of its total aerospace business by the year 2000, is also reevaluating its forecasts. IHI has joined General Electric Co.'s GE90 engine project in an effort to shift sales into commercial areas by committing 30 billion yen (slightly over $200 million at present exchange rates).

These changes may affect the mix of the top 20 Japanese defense contractors over the next 5 years, although MHI is likely to remain the market leader. The biggest potential change is Nissan's position, which has emphasized aerospace production and has placed high hopes on licensed production of the MLRS. If this program does go through, its estimated value of $650 million could elevate Nissan into the top 10 defense producers, and strengthen its position not only for future defense missile programs, but also for commercial ones as well.

Figure 6-2—Defense as a Percent of Total Industrial Production in Japan, 1980-87



SOURCE: *Boei Nenkan* (Tokyo: Boei Nenkan Publishing Co., various editions).

Given the growing importance of electronics in Japanese defense procurements, MHI's sister firm and sometime competitor, Mitsubishi Electric Co. (MELCO), will also have a strong position. Other electronics firms are likely to benefit from the shift in procurement emphasis, including Hitachi, Ltd., NEC Corp., and Fujitsu, Ltd.

Three additional factors may affect long-term planning for Japanese companies. International programs, such as Boeing's commercial transport production and the V-2500 engine, will influence the long-term marketing plans of Japanese firms, especially if defense orders decline. Second, since aerospace is a high government priority, Japan's domestic space program, still relatively small, will assume greater significance in terms of business opportunities to individual firms if defense orders fall. Finally, JDA will increasingly emphasize automated systems in light of the twin constraints of personnel shortages and budgetary pressures. For example, MHI is planning to focus greater efforts on robotics and automated systems both in production and as final systems.[16] Potential applications for the latter range from observation vehicles and target drones to pilotless fighter aircraft.

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[14] There are indications that procurement of major systems may be reduced by as much as $750 million over the next 5 years.

[15] "Gunyo Yori mo, Minsei ni Juten" ("Emphasis on Commercial Products Instead of Defense Demand"), *Asahi Shimbun*, June 21, 1990, Tokyo morning edition, p. 1.

It is not entirely clear how other firms will react to the changes in markets. Some companies, especially those affected by the discontinuation of F-15 and P-3C production, plan retraining programs to shift workers and engineers into other fields. One such example was the plan of a heavy industry company to transfer aircraft production engineers into software projects after 90-day training programs. In general, massive layoffs are not expected in Japanese defense companies, due to the lifetime employment commitment among larger firms: Japan's aircraft industry, which depends on military orders for 70 to 80 percent of its entire business, has maintained steady employment levels for the past several decades.

Regardless of the adjustments that companies in Japan are likely to make in the coming years, however, future procurement budgets will have an important impact on the relative mix of defense business and commercial production, and the status of defense contractors within the Japanese business community.

THE MARKET FOR U.S. EQUIPMENT AND TECHNOLOGY IN JAPAN

Reduced defense budgets in the United States, in Europe, and elsewhere have increased pressure on major contractors to look abroad for new sales. Some observers believe that more moderate procurement increases in Japan may result in greater political pressure to buy cheaper foreign systems off the shelf from overseas sources, especially if the yen remains strong against the dollar. Government and industry are committed, however, to maintaining the maximum feasible level of indigenous production and development. Therefore, it is likely that tighter markets at home and Japan's emphasis on local production will force foreign firms to make Japanese firms more generous technology licensing offers in order to sell in Japan.

However, because Japan's defense market is in a state of flux, the outlook for foreign companies is uncertain over the long term. Many programs that have served as market drivers for several years—F-15, P-3C, etc.—will terminate, and with the exception of the FSX, there are no new military aircraft programs on the horizon. Although the United States and Japan have a gentleman's agreement on FSX production, there is no guarantee that the aircraft will get beyond the prototype production stage. If it does, General Dynamics would reap most of the 40 percent U.S. production work share. That leaves few opportunities for other U.S. firms to deal with Japanese firms. A few development programs are under way, but in some cases (engine development programs, for example) they are directed specifically to reduce Japanese industry's reliance on American sources and in others, such as the medium-range surface-to-air missile project, the Japanese objective is to field a replacement to an existing American product.

Because ongoing procurement, maintenance, logistics, and other support items are likely to be emphasized to maintain the present framework of Japan's Self-Defense Forces, there will be few, if any major contracts available to U.S. producers of front line equipment. Markets will be strong in the electronics areas as Japan upgrades existing aircraft and institutes service life extension programs. But U.S. companies will face serious competition from domestic firms in the electronics areas. These contracts are likely to go to Japanese firms unless foreign companies are willing to consider generous licensing or codevelopment arrangements.

JDA has accepted the higher costs of local production in order to work with Japanese firms instead of foreign ones and to enhance the nation's defense industrial base. It is unlikely that this posture will change as a result of global political shifts or tighter budgets. Autonomy is a high priority for the government, and autonomy ultimately means limited opportunities for foreign companies.

THE ARMS EXPORT ISSUE

One concern that continues to attract attention in the United States is the possibility that Japanese firms might export weapon systems despite long-standing government policies to the contrary. U.S.

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[16] Nobuyuki Oishi, "Defense Firms Responding to Cold War's End," *Japan Economic Journal*, Aug. 4, 1990, pp. 1, 15.

defense contractors have transferred enormous amounts of defense technology to Japan, in part because they believed that Japanese firms would not compete with them in international markets. In the past, the Japanese business community has exerted pressure on government to liberalize arms export policies. This has led to concern among U.S. defense firms that a set of political and/or economic circumstances could combine to break down the policies that currently restrict Japanese defense exports. Some U.S. defense contractors argue that significant exports of dual-use components by Japanese firms indicate that Japan's arms export policies are outdated. They believe that Japanese firms have used the dual-use loop hole to enjoy significant defense business while adhering to the letter of government restrictions on exports of complete weapon systems.

Japan has articulated policies that restrict dual-use exports, but pressure within the business community has risen at times to challenge these policies. Business has argued that by establishing economies of scale through exports, the cost of JDA's procurements would decline and profits would improve. Exports could be used to strengthen ties with friendly nations, which would help to establish greater independence in Japan's foreign policy. Despite these arguments, however, the only significant liberalization of Japan's arms export policies occurred in 1983 when the government agreed to promote exchanges of defense technology with the United States. And even here, amount of Japanese defense technology that has flowed back to the United States under the 1983 agreement has been negligible.

Japan's export potential in defense is ultimately tied to the strength of its domestic market. The paradox is that domestic production must remain constant or expand moderately in order to limit the allure of overseas markets. However, continued strong funding enhances the competitiveness of the domestic industry vis-à-vis global players, thus making it more likely that Japanese firms could in fact compete if they so desired.[17]

For the present, export policies remain intact. While corporate economic interests lie with exports, firms are extremely sensitive to the negative image of arms exports. MITI guidance documents to businesses on export control policies warn repeatedly of the public relations dangers of arms exports, noting that failure to take public opinion into account in these areas will jeopardize commercial sales. The same documents also warn against alienating the public to minimize political pressures in the Diet (against both business and the bureaucracy).[18]

Japan has demonstrated economically and politically that it is willing to support a costly yet modest defense industry that does not depend on exports for survival. JDA and industry are willing and capable of developing and producing high-quality components and complete systems in many areas. Industry has made incremental improvements in its defense production that may eventually reduce the cost of indigenous development and production. The classic pattern of moving from import substitution to export capability is evident in Japanese defense production, but political decisions have restrained industry's movement into the export market (in distinct contrast with its support of industry's advances into international commercial markets). With continued political conviction, Japan's leadership should be able to maintain this policy for the foreseeable future.

Japanese firms are not entirely excluded from foreign defense markets. Vigorous trade in dual-use technologies often enables them to skirt the ban at the component level. Japanese firms can sell dual-use defense components and parts on a company-to-company basis, largely circumventing government policies on arms exports. It is difficult to assess these issues in depth because the degree of Japanese military exports is unclear. In the area of aircraft sales, it has been estimated that only $14 million in defense-related exports originate in Japan annually.[19] This probably understates the extent of Japanese exports to the United States for defense purposes. Virtually all semiconductor and other electronics exports from Japan to U.S. defense contractors are recorded as commercial sales, for example, and U.S. dependence on Japanese technology and products is a longstanding issue in the United States.[20]

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[17] See Keith B. Richburg, "Many Asians Fear Potential Military Threat From Japan," *The Washington Post*, Aug. 4, 1990, p. A18; Charles Smith, "Security Blanket," *Far Eastern Economic Review*, July 5, 1990, p. 11. For a Japanese perspective on these issues, see "Kozo Kyogi Izure Nichibei Anpo ni Fumikomu" ("Structural Talks Inevitably Impact U.S.-Japan Security"), *Ekonomisuto*, Apr. 24, 1990, pp. 44-51.

[18] Japan Ministry of International Trade and Industry, "Factors Affecting Availability of Japanese Dual-Use Technology to U.S. Defense Applications," undated planning document. MITI lists five areas influencing the availability of dual-use technologies to the United States: 1) corporate policies and the individual world views of companies, 2) export administration regulations, 3) media attention and public opinion, 4) data and patent rights, 5) corporate receptiveness: in light of: "consumer environment, you cannot survive a day if you don't have the media on your side, or without popular support." It adds that "the bureaucracy cannot survive. . . if it makes the Diet its open enemy." The Liberal Democratic Party, it concludes, cannot "defend either [the cabinet or the bureaucracy] if and when public sentiments erupt over defense issues."

JAPANESE SELF-SUFFICIENCY IN DEFENSE

JDA programs and procurement over the last 20 years have illustrated a continued drive toward autonomy in defense production and, more recently, in R&D. Although it is doubtful that total self-sufficiency can be achieved in the near future, production trends show a push toward autonomy. Fully 90 percent of Japan's defense equipment is manufactured by domestic producers. But much of the equipment now counted as domestic is U.S.-origin defense systems produced under license in Japan, so the country actually depends more on U.S. industry than might appear. Nevertheless, import substitution programs have been under way since the beginning of the post-World War II period, and have accelerated since the United States ended its military aid programs to Japan.[21]

A slowdown in defense markets might actually enhance indigenous production of weapons in Japan. First, shrinking markets imply greater competition, which might in turn increase pressure on U.S. firms to license technology to Japanese companies in order to remain active in the market.[22]

The decline in superpower tensions could result in reduced emphasis on the development of more exotic technologies and systems such as those anticipated in the Strategic Defense Initiative, and greater emphasis on conventional systems in which Japan could probably develop sufficient capabilities.

Research and Development

Having moved in a significant degree toward autonomy in production, Japanese business is lobbying for higher defense R&D spending to develop new systems. Despite the prospect of defense budget reductions, for example, Keidanren[23] continues to press for a doubling of the budget of the Technical Research and Development Institute (TRDI), JDA's research and development arm, to an amount equal to 5 percent of JDA's current total budget.

There are factors in the nature of TRDI's R&D management and programs that both favor and impede this goal.[24] TRDI has requested a budget for fiscal year 1991 of 115.8 billion yen ($772 million), an increase of 12.5 percent over 1990 but still only about 2.5 percent of the total defense budget. (This is the budget for research, development, testing, and evaluation (RDT&E) and compares to over $40 billion for the U.S. defense budget.) TRDI's budget, however, should be viewed in the light of a national R&D expenditure, government and private of 10.6 trillion yen ($70.7 billion) in fiscal year 1988.[25]

TRDI's strategy is to stretch its relatively modest resources by cultivating promising technologies already under development in the private sector. In this way, TRDI has been able to move rapidly and dramatically in some specific areas, such as the FSX and the active phased-array radar. But this strategy is carried out at the cost of remaining dependent on U.S. defense technologies in other areas. Nevertheless, TRDI programs benefit significantly from extensive Japanese investment in commercial R&D (in fiscal year 1988 it was 7.2 trillion yen or $48.1 billion, almost equivalent to the U.S. commercial R&D investment on an absolute dollar basis), much of which is in dual-use technologies. Financial support can be provided selectively to advanced commercial technologies, enabling private firms to adapt the technology as necessary for defense purposes.[26] As Japan's commercial R&D base grows, so does TRDI's.

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[19] Michael Green, "Japan Looking to Europe To Fulfill Military Needs," *Defense News*, vol.5, No. 25, June 18, 1990, p. 1.

[20] U.S. Department of Defense, Office of the Under Secretary of Defense for Acquisition, "Report of the Defense Science Board Task Force on Semiconductor Dependency," February 1987.

[21] See U.S. Congress, Office of Technology Assessment, op. cit., footnote 3, pp. 66-67; *Boei Nenkan 1990* (*Defense Annual 1990*) (Tokyo: Boei Nenkan Publishing Co., 1990), p. 488.

[22] European firms have made modest gains in Japanese defense markets and could provide a greater challenge to U.S. firms in the future.

[23] Keidanren, the Federation of Economic Organizations, is Japan's largest business organization.

[24] OTA examined Japanese defense research strategies in both U.S. Congress, Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base*, OTA-ISC-420 (Washington, DC: U.S. Government Printing Office, April 1989), ch. 6; and U.S. Congress, Office of Technology Assessment, *Arming Our Allies*, op. cit., footnote 3, ch. 4 and app. C.

[25] Jon Choy, "1990 Update on Japanese Research and Development," *JEI Report*, No. 37A, Sept. 28, 1990, p. 10.

This strategy limits Japan's ability to develop world class weapon systems in particular areas, but currently Japan does not aim for the best and latest in all areas, as does the United States. Achieving self-sufficiency and effective spin-on and spin-off of technology between commercial and military sectors does not require state-of-the-art technology in all areas.[27]

This is particularly evident in the defense electronics area. In the case of MELCO's development of the FSX active phased-array radar, JDA did not pay for the development of the underlying gallium arsenide chip technology or the production process development, which lowered unit costs to a feasible level. However, TRDI has supported radar technology at MELCO at a modest level since 1973, and this steady support for the military application, leveraged by the commercial R&D for the underlying technologies, has proved to be a winning strategy.

Future Collaboration in Defense Technology With Japan

Japanese defense firms will likely take one of two courses during an extended period of tight defense budgets. First, firms may seek international partners to assure their long-term survival in commercial business. This has been seen already on a dramatic scale with the MHI/Daimler-Benz cooperative agreement and to a lesser extent by IHI's steps to develop a cooperative relationship with General Electric. These types of arrangements could lead to global rationalization and more extensive technology transfers in key industries such as aircraft production.

The other possible course would be to shut out potential foreign competitors to preserve dwindling market shares at home. This is most likely in areas such as electronic components, where Japanese capabilities are generally very high, and less likely in areas such as aircraft production and systems integration, where Japan's industry size and capabilities remain limited. A decision by Japanese companies to restrict market access of (and cooperation with) U.S. defense companies would heighten trade-related frictions even in the face of reduced military budgets in both countries and diminishing East-West tensions.

Japanese firms would like to maximize local content in their defense products and at the same time maintain access to foreign technology and material. Defense contractors in Japan, like those in other advanced countries, seek a strong domestic industrial and technology base, a high degree of autonomy, and self-sufficiency.

Japanese Attitudes on Collaboration

Despite the difficulties associated with the FSX program, JDA supports continued collaborative development efforts with U.S. defense firms. Both industry and the military feel Japan needs continued access to U.S. defense technology because it does not have the budget or knowledge to push technology broadly on all fronts. JDA does not think that Japanese defense technology or industry pose a competitive threat to U.S. defense companies, and it does not see itself turning abruptly toward the European Community, despite aggressive efforts by EC member nations to sell weapons to Japan. (Some analysts argue that JDA's recent acquisitions of European aircraft for the Maritime Self Defense Forces suggest the opposite.) Japanese officials believe that the scale of FSX was too large to try as an initial codevelopment effort, but that the United States and Japan will learn together as they proceed.

Japanese industry is generally more interested in selling complete subsystems or components than it is in sharing its technology by licensing or coproduction. Industry simply does not perceive any benefit in licensing its technology to the United States without comparable gains. In commercial areas, these gains most often have been in the form of access to distribution networks or a percentage of an existing market. In the case of straightforward defense sales, such exchanges would quickly become politically sensitive.

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[26] Companies can recoup some of their military-oriented R&D expenses from JDA, either as a charge against future defense contracts for production, or by an administrative overhead charge similar to the U.S. Industrial Research & Development arrangement.

[27] Japan's technology imports in Japanese fiscal year (JFY) 1988 totaled 366.8 billion yen ($2.45 billion), compared to 293.7 billion yen ($1.97 billion) in exports. See Choy, op. cit., footnote 25, p. 20.

In addition to corporate outlook on technology exchanges, business-government interactions tend to restrict the access of outside firms to developing technologies in Japan, unless those firms develop extensive networks over a long period of time. TRDI monitors commercial and dual-use technology through routine contacts with company officials and lab specialists. Because TRDI technical staff are essentially lifelong employees, there is little or no opportunity to move between government and industry. This helps to assure the free flow of information from industry to the government because the possibility of compromising proprietary information is minimized. In this respect, TRDI acts as an honest broker among Japanese firms and the application of their technologies to JDA's needs.

These mechanisms facilitate communication and coordination among these interests and help promote cross-industrial transfers. Meetings between ministry officials and business representatives also provide insights into government R&D initiatives years in advance, assisting companies with their long-term marketing and product development strategies. Considerable overlap takes place between JDA-industry and MITI-industry activities, further assuring extensive integration of JDA with the civilian industrial and technology base.

Possibility of Another FSX

More than any other issue, the possibility of another FSX case arising in the future has shaped U.S. perceptions and questions about defense cooperation with Japan. The notion of planning for another FSX has very opposite meanings, depending on the audience. For Japanese audiences, another FSX implies entering into additional codevelopment arrangements with the United States that might precipitate pressures from Congress across a much broader range of trade, technology, and economic issues. For the United States, it means a potential loss of technology and competitiveness in a critical industry through an ostensibly cooperative program.

It is reasonable to ask if another FSX will in fact make sense for either country in light of the current security outlook and the difficulty of making this program work to the satisfaction of all. FSX has not turned out to be what its Japanese and U.S. proponents expected. Japanese industry underestimated the dimensions of the tasks involved in developing an entire aircraft, even one based on an existing airframe. Resources have been stretched thin in the private sector by the project, to the point where both government and industry are concerned that it will interfere with the ability of companies to devote sufficient attention to civilian projects, such as MHI's Boeing subcontracting work. U.S. Government officials remain uncertain about the benefits of potential flowback of Japanese technology to American industry, and as a result are still ambivalent about participating in the program. The total development costs were substantially underestimated, and making up the difference will be difficult if downward pressures on the defense budget persist.

The prospect of another FSX is also limited because of reduced demand in Japan for new front-line weapons systems beyond those already in various stages of development or delivery. If peace breaks out in Asia as it apparently has in Europe, it is questionable whether there will be sufficient public or government support for the spending increases required to carry out major new weapons programs.

U.S. critics of the FSX project claim that the United States has not received adequate access to Japanese technology in return for what is being transferred to Japan. Others respond that U.S. Government and industry have not been sufficiently active in identifying opportunities to exercise the reverse technology transfer path. There have been three defense-related U.S. Government technology assessment missions to Japan, but to date there have been no technology transfers resulting from them.[28] Japan has proposed five areas for cooperation, and the two governments have begun defining arrangements governing projects in at least three of the five. At this pace, however, the United States cannot expect that any more than a trickle of projects will result in transfers of Japanese technology to the United States.

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[28] Defense Department teams have examined electro-optics and millimeter wave technology and manufacturing processes. The results of their assessments were published in U.S. Department of Defense, Office of the Under Secretary of Defense (Acquisition) for Research and Advanced Technology, "Electro-optics and Millimeter Wave Technology in Japan," May 1987; and Dr. Clinton W. Kelly et al., "Findings of the U.S. Department of Defense Technology Assessment Team on Japanese Manufacturing Technology," June 1989. In addition, a delegation from the U.S. Army Materiel Command assessed Japanese technologies in U.S. Army Materiel Command "Assessment of Research and Development Opportunities in Defense-Related Technologies," U.S. Army Materiel Command, September 1989.

One of the primary problems facing U.S. firms that would like to collaborate in defense technology with Japanese companies is the difficulty in assessing the current state of Japanese technology. Despite steps made to rectify this situation, the United States remains insufficiently informed on the state-of-the-art in Japan. Furthermore, assessments often conflict. For example, in the case of the MELCO phased array radar, teams from the General Accounting Office (GAO) and the U.S. Air Force (USAF) reached strikingly dissimilar conclusions regarding Japanese capabilities. GAO found that Japanese production facilities were of "soldering iron vintage."[29] GAO also concluded that the United States is well ahead of Japan in the critical areas promoted as benefits to the United States for participating in the FSX project, including wing composites and the phased array radar. In examining many of the same facilities, technologies, and issues, the USAF team concluded in contrast that "Japanese facilities are as modern and well-equipped as anything to be found in the United States. MELCO's modular technology to be used in the FSX radar is not far behind that of the U.S."[30]

Although there is support in some Japanese business and government circles for accelerating the pace of reciprocal technology transfer, there are a number of specific obstacles to transferring defense technology from Japan to the United States. On the Japanese side, there is 1) a narrow interpretation of the 1983 accord with respect to transfers to the United States, 2) a restrictive policy on third-country resales, and 3) a question of the definition of the term "dual-use" (see box 6-A). Each of these barriers is outlined below.

There is an elaborate process in Japan for the approval of technology transfer to the United States, depending on whether the item is for a purely commercial, dual-use, or military application. If a product is purely commercial, it can be sold under the normal commercial export licensing system. In theory, nonmilitary technologies need not be approved for export by the Joint Military Technology

Box 6-A—Japanese Military and Dual-Use Technologies

The Japanese Government defines "arms" as any of the following items (as stipulated in the Export Trade Control Order of Japan and the Policy Guideline of the Government of Japan on Arms Export of Feb. 27, 1976):

1. Firearms and cartridges to be therefor (including those to be used for emitting light or smoke), as well as parts and accessories thereof (excluding rifle-scopes).
2. Ammunition (excluding cartridges), and equipment for its dropping or launching, as well as parts and accessories thereof.
3. Explosives (excluding ammunition) and jet fuel (limited to that the whole caloric value of which is 13,000 calories or more per gram).
4. Explosive stabilizers.
5. Military vehicles and parts thereof.
6. Military vessels and the hulls thereof, as well as parts thereof.
7. Military aircraft, as well as parts and accessories thereof.
8. Antisubmarine nets and antitorpedo nets as well as buoyant electric cable for sweeping magnetic mines.
9. Military searchlights and control equipment thereof.
10. Bacterial, chemical, and radioactive agents for military use, as well as equipment for dissemination, protection, detection, or identification thereof.

According to the 1983 notes, "The term 'military technologies' means such technologies as are exclusively concerned with the design, production and use of 'arms' " as defined in the Policy Guideline of the Government of Japan on Arms Export of Feb. 27, 1976 and the Export Trade Control Order of Japan. "Arms" by definition "are to be used by military forces and directly employed in combat." The Policy Guideline states further that equipment related to arms production will be treated in the same manner as arms.

Any other technologies by implication are considered commercial or defense-related (but other than military).

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[29] U.S. Congress, General Accounting Office, *U.S.-Japan Codevelopment: Review of the FS-X Program*, NSIAD-90-77BR (Gaithersburg, MD: U.S. General Accounting Office, February 1990), p. 29.

[30] Unclassified executive summary of USAF trip report, May 1990, p. 5.

Commission (JMTC).[31] In practice, however, military technologies have been defined by the Japanese Government, and by MITI in particular, by their end use, not necessarily by their origin or potential for applications in commercial or military products.

If a product is considered to be dual-use, the Japanese seller is required to obtain a significant amount of information from the buyer regarding the end-use of the item. This includes a certification by the end user that the item will not be used as a weapon or as part of a weapon. This process is said to take 1 to 3 months. If the item is scheduled for a military application, there is additional scrutiny by MITI and the JMTC. In the past there have been several cases where dual-use technology transfers were denied by MITI because they specifically were headed for a military contract. This situation is particularly applicable to electronic components and subsystems, and has the effect of discouraging export applications, both by Japanese and U.S. firms. MITI claims to be trying to reverse this impression, but there have been few test cases to date.

A final concern is that U.S. defense systems often are shared with other allies, and Japanese regulations forbid third-country transfers. Furthermore, many Japanese advanced defense concepts have commercial components included in them that are not owned by JDA. Consequently, Japanese companies that own the technology may require a royalty or other payment in return for their commercially developed technology. A suggestion has been made in Japan that JDA should buy the technology from industry so that they are in a better position to negotiate with the United States, although the mechanics of this type of arrangement could be costly and cumbersome.

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[31] The U.S.-Japan Joint Military Technology Commission (JMTC) was established by the November 1983 notes on technology transfers to facilitate actual exchanges. It consists of representatives from Ministry of International Trade and Industry, the Japan Defense Agency, Ministry of Foreign Affairs, and senior representatives from the U.S. Embassy in Tokyo. For additional details on the mechanics of transferring technologies utilizing the JMTC, see U.S. Department of Defense, Office of the Under Secretary of Defense for Research and Engineering, "Japanese Military Technology: Procedures for Transfers to the United States," February 1986.

Chapter 7

The Developing Defense Industrial Nations: South Korea, Brazil, India, Taiwan, Australia, Indonesia, and Singapore

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Chapter 7

The Developing Defense Industrial Nations: South Korea, Brazil, India, Taiwan, Australia, Indonesia, and Singapore

COLLABORATION AND DEFENSE INDUSTRIAL PROLIFERATION

During the period 1970-90, several of the developing nations achieved remarkable growth in their defense production capabilities. The expansion of the defense industries has been accompanied by the increasing sophistication of their military products —advanced fighter aircraft, tanks, armored personnel carriers, missiles, and naval craft. Brazil has demonstrated its marketing capabilities by exporting intermediate-level weapon systems to many developing countries as well as to the United Kingdom. The production and R&D capabilities of the developing countries have been augmented by licensed production agreements and other forms of military technology transfer from U.S., Soviet, and European defense companies (see figure 7-1).

This chapter provides an overview of the various methods that the developing nations have used to acquire defense production capabilities. Subsequent chapters (chs. 8-11) examine the defense industries and policies of South Korea, Brazil, India, Australia, Singapore, Indonesia, and Taiwan.[1] These chapters provide a comparison of the differing manufacturing and export capacities of these counties. The analysis also reviews substantially increased involvement by U.S. companies in the defense industrial bases of the developing nations.

Defense production in these countries stems from an amalgam of strategic, political, and economic motivations. Strategic considerations—improved self-reliance, ensured security of supply, regional power aspirations, and local arms races—have often initiated the development of arms industries in the newly industrializing countries. India's extensive military buildup has been tied to its regional arms race with China and Pakistan. Taiwan's development of an indigenous fighter airplane may have been motivated by its desire for self-reliance in view of U.S. refusals to sell it sophisticated aircraft. Indonesia's recent effort to build an arms industry appears to complement its regional aspirations within Southeast Asia.

Increasingly, economic incentives play an important role in motivating the newly industrialized nations to undertake extensive arms production. These countries argue that indigenous production can lead to cost reductions and potential foreign exchange earnings through exports. Additionally, defense programs are believed to contribute to the civilian economy indirectly by providing spin-offs to other industrial sectors, and by upgrading the skills and productivity of the industrial labor force.

The ability of these states to establish indigenous defense production capacity is conditioned by several factors. Large amounts of capital are necessary to establish such a technologically intensive industry. Massive investments are required to build manufacturing facilities, create R&D centers, and to pay for imports. Additionally, government expenditures, through domestic defense procurement budgets, are often a prerequisite, given the small size of local markets. Australian defense production, for instance, has been severely hampered due to its small domestic procurement budget.

A second component is a diversified industrial base. Defense production, particularly in the aerospace sector, is one of the most complex manufacturing activities, and requires extensive industrial inputs from such sectors as steel, metallurgy, machinery, and electronics. The recent increase in arms production among such defense industrializing countries as Singapore and Indonesia is explained in large part by their growing manufacturing capabilities.

A third factor relating to the arms-producing capabilities of developing countries is the status of domestic scientific and educational facilities. As evidenced in the subsequent chapters, the arms industries of India, Singapore, and Taiwan have provided the impetus for the creation of institutions for scientific research and applied technology. However, the majority of the developing countries

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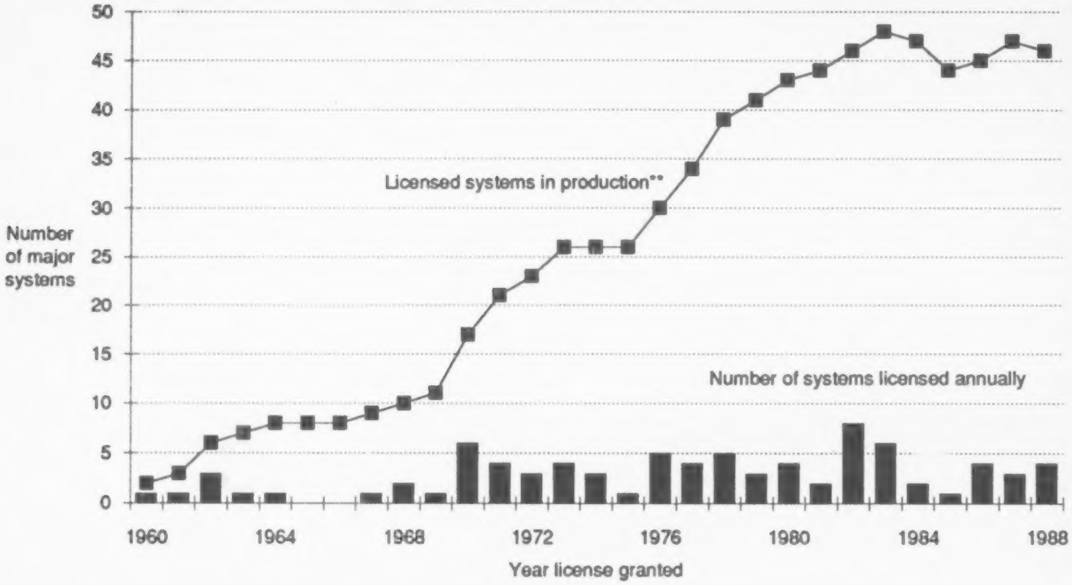
[1] For an analysis of defense production in the newly industrializing countries see Carol Evans, *Defense Production in the NICs: The Case Studies From Brazil and India* (London: London School of Economics, Spring 1991), passim.

Figure 7-1—Estimated Licensed Production of Major Conventional Weapon Systems in Selected Developing Nations,* 1960-88



*Brazil, India, South Korea, Indonesia, Taiwan, Singapore, and Australia.
**Estimates based on the assumption that an average system is produced under license for 12 years.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

do not possess advanced R&D programs or institutions for educating technicians and scientists.

Among the developing nations, strong state involvement through direct ownership of the defense industries is frequently a means of ensuring the viability of domestic defense firms. Governments have also provided various fiscal and trade incentives to help both domestic and foreign defense companies reduce their defense production costs. The state-controlled aircraft industries in India, Indonesia, Singapore, and Taiwan are good examples. The Singaporean case also demonstrates that if a country does not have a sizable government or private aircraft industry, it can create one by attracting foreign investment.

The final factor affecting arms production is access to export markets, primarily in the developing world. Arms producing countries like Brazil and Australia, which suffer from bottlenecks created by the high costs of production and the small size of their peacetime domestic requirements, must export to maintain the economic viability of their defense industries. In fact, the ability of the developing countries to tailor defense production to external demand, and to compete aggressively in the international arms market distinguishes those with long-term production potential.

Most nations with developing defense industries have followed a common process to establish domestic defense production. The acquisition of an indigenous manufacturing capability, or the import of technology or technological know-how, is often a continuation of direct arms imports. Domestic production may begin with the assembly under license of knocked-down weapons and the manufacture of components. Sophisticated equipment, however, continues to be imported. At a more advanced stage, developing countries design and produce their weapon systems domestically, including components, while still relying on imports of the more advanced technologies, for example, avionics.

A number of factors reconfigured the international arms trade in the 1980s. The cumulative effect of these changes has reinforced the arms production activities of and technology acquisitions by these defense industrializing states. The most important shift was the erosion of U.S. and Soviet market shares in the international arms trade in the face of growing competition from West European defense suppliers.[2] As one U.S. defense executive noted, "Not only are the numbers of players increasing, but through processes of technology transfer and national commitment, we are finding more aggressive competitors out there."[3] The subsequent emergence in the 1980s of a buyers' market for arms, and the enhanced technological capabilities of developing arms producers, provided the latter with the additional leverage to secure licensed production and offset agreements. Moreover, transfers increasingly consisted of military technology, not simply the provision of finished military weapon systems.

Licensed production arrangements have been heavily favored by most developing arms producers. In return for the production of proven weapon systems, governments can conserve foreign exchange and upgrade their countries' technological bases. Licensing is also attractive because of its inherent flexibility. Agreements can be secured to allow for a broad range of manufacturing activities including components, subassemblies, or the production of a complete weapon system and its components.[4] Of the developing countries considered in this report, South Korea, India, Taiwan, Singapore, and Indonesia have relied extensively on licensed production from foreign companies as a means of acquiring and expanding their defense industrial capabilities.

A second, less frequently used means to acquire defense-related technologies is through joint venture agreements and company-to-company teaming with U.S., European, and increasingly other developing defense industrial nations. The economic advantages of collaborative arrangements are threefold:

1. risk sharing and reduction of technical and commercial processes inherent in the development of new weapon systems;
2. access to partner's technology and capital resources; and
3. marketing and reputation benefits.

In the past 5 years, defense collaboration has moved into the early research and predevelopment stages with companies cooperating on design, fabrication, and application of advanced technologies. This approach, however, is restricted to relatively advanced arms producers. Brazil's aircraft industry, for example, has various collaborative international arrangements with Italy's Aeritalia and Aermacchi as well as with Argentina's aircraft industry, Fubrica Argentina de Materiales Aerospaciales.

Another means to supplement a developing country's defense industrial sector is through subcontracts with large international defense companies. Many U.S.- and European-based companies have established production lines in the countries belonging to the Association of Southeast Asian Nations (ASEAN) to take advantage of their low wages and skilled labor. Companies are also attracted to these countries because their location provides market access in the Far East. The development of arms production programs in the ASEAN states of Singapore and Indonesia has been greatly aided by the defense manufacturing operations of such companies as United Scientific Holdings of the United Kingdom, and General Dynamics of the United States.

Since the 1980s, defense firms have been forced increasingly to provide offsets to secure sales. Although there are many kinds of offset agreements, the most common are direct offsets in which the purchasing country manufactures and supplies components in connection with the purchase of a foreign weapon system. These have stimulated the development of new arms industries, particularly when the foreign company supplies technical data and trains local technicians. The offset arrangements between General Dynamics and Singapore and Indonesia for the acquisition of the F-16 enabled these countries to save foreign exchange and to provide work and valuable production technology for their domestic defense industries. Experience gained in such transactions often leads to future licensed production and even to attempts at indigenous development.

An analysis of defense industrialization in Brazil, India, and South Korea and among several Western

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[2] For data relating to these shifting market shares see Richard Grimmett, "Trends in Conventional Arms Transfer to the Third World, by Major Supplier, 1982-1989," CRS-90-298-F (Washington, DC: Library of Congress, Congressional Research Service, 1990).

[3] Quoted in Richard W. Stevenson, "No Longer the Only Game in Town," *The New York Times*, Dec. 4, 1988, p. F7.

[4] Trevor Taylor, "Defence Industries in International Relations," *Review of International Studies*, vol. 1, 1990, p. 61.

Pacific countries shows differing levels of defense manufacturing and export capabilities. During the 1980s, Brazil ranked first or second (after Israel) in terms of defense production and exports among the developing countries. Building on international collaborative and licensing agreements, Brazil's defense industries became highly diversified and sophisticated producers of military equipment. The Persian Gulf and Middle East states such as Iraq and Libya have been the largest purchasers of Brazilian arms. In the Brazilian case, the acquisition of dual civil and military technologies enabled some Brazilian firms (e.g., Embraer) to compete successfully in the U.S. and European aircraft markets. However, while the Brazilian model has encouraged the defense production activities of other new entrants, it is unlikely to be duplicated successfully. Moreover, the international embargo against Iraq has damaged the export viability of Brazil's arms industry.

India provides a paradoxical example of a country that possesses the largest military-industrial-research complex of the developing nations, and at the same time depends disproportionately on transfers of foreign defense technology. Its failed policy of self-sufficiency (because of overly ambitious attempts to produce sophisticated weapon systems) has necessitated substantial imports from and licensing agreements with the Soviet Union and more recently with West European states.

South Korea's heavy reliance on U.S. foreign military assistance to meet its security requirements and to finance U.S. arms imports is gradually being replaced by collaboration and coproduction agreements with U.S. defense companies. Similar to the experiences of other developing countries with larger defense sectors, the growth of South Korea's arms industry since the 1970s has been closely linked to a strategy that emphasizes the expansion of the shipbuilding, machinery, and electronics industries. However, unlike many of the other developing countries, South Korea has pursued partnership with U.S. and foreign defense firms rather than self-sufficiency. Future government efforts to strengthen South Korea's partnership strategy, such as supplying components to major U.S. aerospace defense firms and increasing defense exports, greatly depend on continued U.S. willingness to transfer military-related technologies.

The Western Pacific countries (reviewed in ch. 11) are also heavily involved in defense industrialization. The development of arms industries in Australia, Singapore, Indonesia, and Taiwan has been conditioned by reductions in security assistance provided by the United States and the United Kingdom, for example, the British decision in 1971 to withdraw its defense forces from Malaysia and Singapore, and the U.S. military withdrawal from Indochina in 1975. Financial and technological limitations have led Indonesia and Singapore especially to concentrate their defense production activities on overhaul, modernization, and international subcontracting, mainly for the aircraft sector. While the juxtaposition of Australia and Taiwan reveals significant differences in strategic priorities, both countries have sought to improve the future self-sufficiency of their arms industries through collaboration with foreign defense firms.

U.S. defense companies are involved in the defense industries of all the Western Pacific nations examined in this report. This involvement includes transfers of technology through licensed production, joint ventures, and direct foreign investment. As a result, the defense industries of the Western Pacific countries are highly import dependent. Nonetheless, these countries are likely to exploit foreign defense companies' growing interest in the Asia-Pacific region and to secure transfers of technologies that will enable them to move from primarily subcontracting and direct offsets into licensed production of finished weapon systems.

The ramifications for U.S. foreign policy arising from defense production and exports by the defense industrializing countries are far-reaching. The relatively unrestrained spread of conventional arms, as well as naval and ballistic missile proliferation, has been facilitated by U.S. and West European technology transfers. International efforts such as the Missile Technology Control Regime will have only limited countervailing effectiveness because of the growth of defense cooperation between developing nations.

Conventional Arms Trade Among Developing Nations

Arms production and exports by countries like Brazil have had an important effect on the growth of defense trade among the developing nations.[3] As discussed in the subsequent chapters, developing countries are increasingly purchasing military equipment and technology from the defense industrializing countries. Many of these recipients are countries that are diversifying their sources of weapons supply in order to circumvent arms embargoes or simply to reduce the influence of their traditional suppliers. Examples of such recipients among the developing countries are Iraq, Iran, and Taiwan.

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[3] See Carol V. Evans, "Reappraising Third World Arms Production," *Survival*, vol. 28, No. 2, March/April 1986, pp. 99-118.

In addition to military hardware, some developing nations are beginning to transfer the technology and infrastructure necessary to develop defense products. In October 1984, for example, Brazil and Saudi Arabia signed a 5-year military cooperation agreement for the technical training of Saudi workers in weapons assembly and the joint manufacture of the Astros II multiple-rocket launcher. Another important example is the 1984 licensed production agreement between Brazil and Egypt for the Tucano trainer. Of the 120 planes assembled in Egypt, 80 were delivered to Iraq and 40 were retained by the Egyptian Air Force. In both cases, financing was provided by Saudi Arabia through the Gulf Cooperation Council.

This trend in conventional weapons trade among nations of the developing world has significantly undermined control over weapons trade and regional conflicts. For example, the Brazilian Government's ban on arms exports to Iran during the Iran-Iraq war did not deter or prevent Libya—Brazil's second largest arms importer—from supplying Brazilian spare parts to Iran.[6]

Naval Arms Proliferation

As indicated in the chapters that follow, India, Taiwan, and Indonesia have been expanding their naval capabilities through indigenous defense production efforts or through off-the-shelf purchases. Situated along strategic sea lanes or at choke points, each of these countries has arrived separately at the same hardware solutions to their sea-denial defense postures: missile-firing fast attack craft, helicopters, maritime surveillance aircraft, and submarines.[7] Over the past 10 years, Indonesia and Taiwan have either licensed-produced or purchased fast attack craft and patrol vessels from West German and Israeli sources, respectively. (As discussed later, Indonesia's naval expansion is linked to its monitoring and policing of its Exclusive Economic Zone.) According to the Stockholm International Peace Research Institute:

> Many of these craft share the following characteristics: twin propulsion systems for economical patrol with greater speed; . . . sizable and separated storage areas located where they can become magazines; . . . helicopter facilities; communications systems; extensive crew quarters to allow increases in the ship's company if helicopter, anti-submarine warfare (ASW), or electronic warfare (EW) operations should ever be undertaken and hard points for the attachment of equipment such as sonars or missile systems.[8]

In addition, changes in submarine technology have had a profound impact on current naval balances. The development of air-independent propulsion systems for submarines, which could then be armed with a missile capability, could threaten aircraft carriers.[9] India's lease of a Charlie I-class, nuclear-powered submarine, and its purchases of West German 209, Soviet Kilo and Foxtrot submarines mark a significant jump in India's naval capabilities. India would now be better able to counter the threat it faced in its 1971 war with Pakistan, when the U.S. Navy deployed its Seventh Fleet into the Bay of Bengal. These acquisitions, along with the induction of a second aircraft carrier, have raised concern about India's regional ambitions.[10] Similarly, Indonesia, which is planning to build a large naval base on Sumatra for quick access to the Bay of Bengal, is worried about the Indian Navy.

Missile Proliferation

A relatively new development is the proliferation of ballistic missile programs by the newly industrializing countries. Nine countries possess or are developing indigenously surface-to-surface missiles with ranges of 600 to 2,000 km.[11] Central to this study are the countries of Brazil, India, and Taiwan.

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[6] Veja, Sao Paulo, Oct. 22, 1986, p. 59.

[7] Commodore K. R. Menon, Indian Navy, "Third World Navies React," *Proceedings of the U.S. Naval Institute*, March 1989, p. 89.

[8] Ian Anthony, "The Naval Arms Trade and Implications of Changes in Maritime Law," SIPRI Yearbook 1988, *World Armaments and Disarmament* (Oxford: Oxford University Press, 1988), p. 275.

[9] Menon, op. cit., footnote 7, p. 94.

[10] Ross H. Munro, "Superpower Rivalry," *Time* (International edition), vol. 133, No. 14, Apr. 3, 1989, p. 13.

In addition to heightening international tensions and further spurring regional arms races (especially in South Asia), these countries' missile programs have prompted concern by the United States, its European partners, and the Soviet Union regarding the potential deployment of nuclear, chemical, or biological warheads. The U.S. response to this missile proliferation was to restrict the export of sensitive technology with the establishment in 1987 of the multilateral Missile Technology Control Regime (MTCR). Seven nations (the United States, the United Kingdom, Japan, West Germany, France, Italy, and Canada) initially agreed to ban the export of complete missiles or components for missiles with ranges of more than 300 km and of payloads over 500 kg.[12]

Nonetheless, as evidenced by India's test of its Agni intermediate-range missile, missile programs continue, despite the restrictions of the MTCR. Ironically, one of the main reasons for the relative failure of the MTCR is the continued assistance by regime members to these countries' civilian space programs. For example, the French-led Arianespace has offered to provide Brazil's space program with Viking rocket engine technology and training for Brazilian technicians.[13] Similarly, West Germany is reputed to have aided India's missile capabilities by assisting its space research program.[14] Another factor weakening the MTCR is the ready availability of the 300 km Soviet Scud-B and other short- and medium-range missiles being retired from Soviet and NATO inventories. Various countries, including Iran and Iraq, have sought foreign assistance to modify and extend the range of the Scud-B missile.

Cooperation among the developing nations in ballistic missile technology continues. In 1988, Argentina, Egypt, and Iraq formed a consortium to produce the Condor II ballistic missile. Over the last 5 years Brazil has been actively involved in Iraq's ballistic missile program and has reportedly helped Iraq extend the range of its Scud-B missiles.[15] Israel assisted Taiwan's development of the Hsiung-Feng surface-to-surface missile.

Missile cooperation has also contributed to regional arms races. The sale of East Wind CSS2 missiles in 1988 by China to Saudi Arabia sent ripples throughout South and East Asia. The Saudi deal alarmed Taiwan particularly. China had made a bold inroad into a country with which Taiwan has enjoyed strong diplomatic relations. Furthermore, these missiles were capable of hitting Israel, a country that has provided both Taipei and Beijing with high-technology defense equipment.[16] Doubtless Taiwan's own development of its 1,000 km range missile, Sky Horse, has been spurred by the Beijing's missile sale. India's concern has been more muted as these missiles—though capable of reaching the Indian west coast—are deployed against Iran. Still, as a prominent Indian defense analyst wrote in the *Times of India*, "these developments highlight the need for India to expedite its own missile programs."[17]

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[11] "The Missile Race Hots Up," *South*, August 1989, p. 102.

[12] For an overview of the effectiveness of the MTCR, see Janne E. Nolan, "Ballistic Missiles in the Third World—The Limits to Non-Proliferation," *Arms Control Today*, vol. 19, No. 9, November 1989, pp. 9-14.

[13] "U.S. Objects to Deal on French Missile Know-How," *Latin American Regional Reports: Brazil*, Nov. 23, 1989, p. 8.

[14] John J. Fialka, "Space Research Fuels Arms Proliferation: Indian Missile Suggests U.S., West German Parenthood," *The Wall Street Journal*, July 6, 1989, p. A8.

[15] "Cientista das Arabias," *Veja*, Oct. 3, 1990, pp. 48-50.

[16] Nayan Chanda, "The Third World Race for Ballistic Missiles," *Far Eastern Economic Review*, June 2, 1988, p. 22.

[17] K. Subrahmanyam, "Chinese Missiles and Indian Security," *Times of India*, quoted in *India Weekly*, Apr. 22, 1988, p. 10.

Chapter 8

The Defense Industry of South Korea

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Chapter 8

The Defense Industry of South Korea

THE ROLE OF GOVERNMENT

The South Korean Government has nurtured the development of a defense industry since the early 1970s. Three measures promulgated at that time have set government policy: a Special Law on the Defense Industry (1973), a Force Improvement Plan (1974) for the buildup of the Republic of Korea (R.O.K.) armed forces, and a Defense Tax Law (1975) to finance the development of the defense industry.

Government support for defense industries was related to the general government policy in the 1970s of fostering investments in such industries as heavy machinery, shipbuilding, steel, and electronics. The growth of these industries provided linkages to developing defense production, as the manufacture of weapons became integrated into the broader production of heavy machinery and ships.

The South Korean Government has followed a policy mixture of pressure and incentives for companies that enter the defense business. Concessional financing—loans at below market interest rates—has been extensive for the defense sectors of such companies. The government has eliminated tariffs and quotas on imports needed for defense production. Employees of Korean companies involved in defense work receive exemptions from the military draft. The government is prepared to assist key defense firms that fall into financial difficulties.[1]

Pressure and control have been equal to incentives in government policy. In the 1970s and early 1980s, the government made the financing and licensing of commercial production depend on the willingness of Korean firms to go into defense production. The government closely manages production levels, marketing, and the export of weapons and military equipment.

The government also dominates weapons R&D. The Agency for Defense Development (ADD) has carried out most of the research and design of weapon systems. Defense firms generally enter the picture by producing prototypes based on ADD designs. The ADD also has a role in managing the relatively small amount of R&D carried out by defense companies.

The South Korean defense industry currently comprises some 80 firms, which employ about 45,000 people. Of the 80 firms, 44 have over 500 employees. The government in recent years has tried to foster smaller and medium-sized companies in the defense field. Nevertheless, a small number of giant corporations dominate the defense industry just as they do in the civilian product sector. Many of these corporations, known as the *chaebol*, now have international reputations: Samsung, Daewoo, Hyundai, and Lucky Goldstar. These corporations produce textiles, automobiles, home appliances, and electronics products, and engage in ship building and construction. Within the defense industry, they manufacture the majority of systems that South Korea produces.[2] Many of the smaller Korean companies in defense work engage mainly in subcontracting to these giants.

Given the size and the range of activities of the chaebol, defense work comprises a small percentage of their business. For example, Hyundai Precision Industries, a division of the Hyundai conglomerate, devotes only 15 percent of its work to defense, according to company officials interviewed in May 1990. Many of the component companies of the Daewoo Corp. are involved in defense production, but this amounts to less than 10 percent of Daewoo's total business. Defense products comprise about 25 percent of the sales of Samsung Aerospace, a component of Samsung Corp.

Nevertheless, the chaebol will spearhead the future of South Korea's defense industry, and will no doubt be the leaders in manufacturing new systems. Their role in R&D will likely expand. They will dominate future collaborative and joint venture endeavors in military production between Korean firms and United States or other foreign companies.

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[1] Chung-in Moon and Kwang-il Baek, "Loyalty, Voice, or Exit? The U.S. Third-Country Arms Sales Regulation and ROK Countervailing Strategies," *Journal of Northeast Asian Studies*, vol. 4, spring 1985, p. 42.

[2] Mike Howarth, "Defending the Republic of Korea: Armed Forces and Industry Forge Ahead," *International Defense Review*, No. 2, 1986, pp. 193-197.

ACTIVITIES OF U.S. DEFENSE FIRMS IN SOUTH KOREA

South Korea occupies a place second only to Japan in the activities of American defense firms in East Asia. U.S. defense companies have conducted extensive business in South Korea, and the potential for expanded business appears to be great. A continued growth of defense business, however, raises several policy questions for the U.S. Government regarding the future of U.S. defense industries and foreign and technology policy priorities.

U.S. defense firms currently are engaged in three types of business in South Korea:

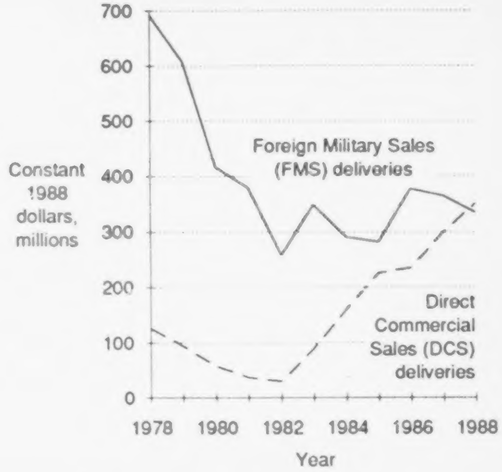
1. the direct sale of weapons and other military-related items to South Korea,
2. collaborative relationships with South Korean firms—licensing and coproduction—for the assembly or production in South Korea of U.S.-designed weapon systems, and
3. contractual arrangements under which South Korean companies supply components to American firms for the manufacture of U.S. weapons systems in the United States.

The three types of cooperation are often integrated in the industry relationships between U.S. and Korean firms.

South Korea ranks with Australia, Japan, and Taiwan as a leading market in the Western Pacific for U.S. exports of arms and military-related equipment. U.S. military exports have been conducted commercially or under the Foreign Military Sales (FMS) program of the Defense Security Assistance Agency (DSAA). The United States has removed South Korea from the list of countries eligible for future FMS credit financing; however South Korea has continued to make cash purchases under FMS because it sees advantages to U.S. Government oversight of transactions between Korean and American companies. Direct commercial exports (from U.S. companies to Korean firms) rose in the late 1980s and may even surpass FMS exports by the late 1990s, once current FMS agreements are implemented.

Both FMS and commercial sales are expected to expand in the early 1990s, according to estimates of the Joint U.S. Military Assistance Group, Korea. FMS exports probably will exceed $800 million annually by 1995, and commercial sales should reach $800 million in that year (see figure 8-1).

Figure 8-1—Foreign Military and Direct Commercial Sales Deliveries From the United States to South Korea, 1978-88 (constant 1988 dollars, millions)



SOURCE: Office of Technology Assessment, calculated from data in U. S. Department of Defense, Defense Security Assistance Agency, "Fiscal Year Series," Sept. 30, 1989, p. 34.

An important part of U.S. military exports has been the supply of U.S. parts and components for the assembly of American weapons and equipment in South Korea. This has been the major form of collaboration between U.S. and South Korean firms since the early 1970s. Coproduction emerged in the 1980s as a more advanced form of collaboration, in which Korean firms produced agreed-upon percentages of the components of U.S. weapons systems assembled in South Korea.

The following are examples of major collaborative endeavors:

1. the assembly of F-5E and F-5F aircraft by an affiliate of Korean Air in collaboration with Northrop;
2. the assembly of MD500 helicopters by an affiliate of Korean Air in collaboration with McDonnell Douglas;
3. the assembly of the 5.56 mm Colt M-16 rifle by the State Arsenal in Pusan, South Korea;
4. coproduction of the M167A1 Vulcan anti-aircraft gun between the Daewoo Corp. and General Electric; and
5. assembly of the U.S. 155 mm and 105 mm howitzers by KIA Machine Tool Corp.

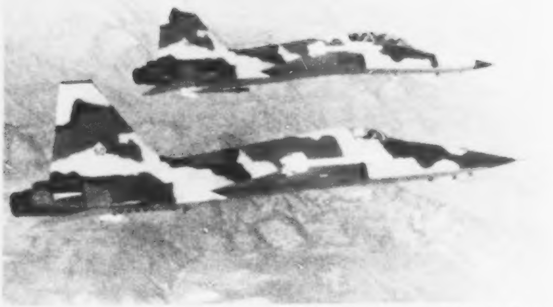


Photo credit: U.S. Air Force

Northrop Corp.'s Tiger II F-5E (foreground) and F-5F have been built under license in South Korea, Switzerland, and Taiwan. The F-5 series is one of the most widely used U.S. military aircraft, with 3,805 having been built between 1959 and 1987.

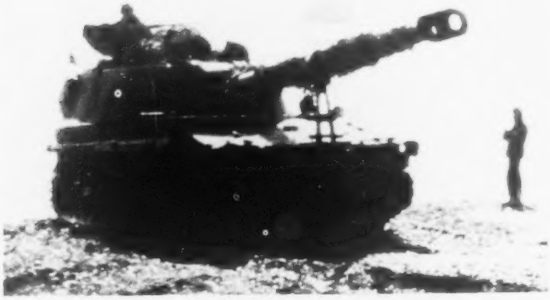


Photo credit: U.S. Army

The U.S. M-109 155 mm self-propelled howitzer was first fielded in the United States in the early 1960s, and has been upgraded frequently since. Assembly of the M-109A2 version by South Korea's KIA Machine Tool Corp. began in 1983.

Joint venture collaborative arrangements sometimes have led to subcontracts under which Korean firms produce components that go into military and civilian systems, manufactured in the United States by American defense firms. Korean firms, for example, produce several airframe parts for the F/A-18 fighter manufactured in the United States by McDonnell Douglas. Korean companies also make composite materials for the General Dynamics F-16 fighter, and produce parts for McDonnell Douglas, Sikorsky, and Bell helicopters. The Daewoo Corp. produced wings for the Lockheed P-7 naval aircraft. The extent of these subcontractor relationships is unknown. In 1989, South Korea exported $182 million in aircraft and aircraft parts.[3] It is reasonable to assume that a sizable majority of these exports went to the United States.

SOUTH KOREA'S PARTNERSHIP STRATEGY

Like their Japanese counterparts, South Korean Government and industry leaders seek to increase the percentage of weapons and military equipment produced locally, but they do not appear to aim for an independent defense industry with no foreign involvement. Long-term aims, however, are uncertain. South Korean leaders speak of a growing partnership between Korean firms and foreign companies, especially U.S. corporations, in producing weapons systems. They seek collaborative relationships in which Korean firms assume a progressively greater and more equal relationship status with U.S. partners. Korean officials assert that South Korea needs an independent capability for maintenance of its military equipment, for which it currently depends on the U.S. military. They believe that these objectives should be achieved through an acceleration of technology transfer from U.S. companies to their Korean partners, which will allow Korean firms to produce more sophisticated components and complete systems and be able to provide full service and maintenance to systems in South Korea's military arsenal.

South Korean officials have outlined three elements of this partnership strategy. One is to develop a significant role for Korean firms as suppliers of components and parts to major U.S. defense firms that produce in the United States. South Korean leaders stress the advantages of Korea supplying components and parts at reduced costs, as major U.S. defense corporations face declining U.S. defense budgets, fewer contracts, and a greater need for efficiency and cost-cutting. This, they argue, would allow American firms to retain the lead in developing advanced technology while economizing on standard parts and components through subcontracting with Korean companies.

South Korea has instituted an offset policy toward U.S. and other foreign suppliers similar to those of

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[3] "Korea Threatens To Scrap F/A-18 If Classified Technology Excluded," *Defense Daily*, May 18, 1990, pp. 277-278.

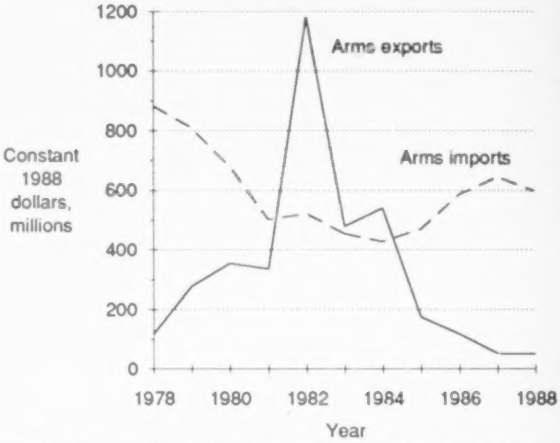
Japan and Western European countries to induce U.S. firms to subcontract for Korean-produced components and parts. Under such agreements, U.S. defense companies selling or coproducing in South Korea would purchase Korean products at a specified level. In the now-abandoned F/A-18 coproduction deal, the Seoul Government and Samsung Aerospace sought offsets from McDonnell Douglas equal to 20 percent of the expected profit of the U.S. company (plus another 10 percent in indirect sales). South Korean Government and industry officials saw the F/A-18 transaction as opening opportunities for expanded subcontractor relationships between Korean companies and McDonnell Douglas and presumably have similar expectations in their dealings with General Dynamics on the proposed F-16 coproduction deal.

Exports are a second element of the "partnership strategy," and are integral to South Korea's defense industry policy. The Korean Ministry of National Defense stated in its *Defense White Paper, 1989* that the defense industry has no alternative but to turn to overseas markets.[4]

Since the late 1970s, South Korea has exported several hundred million dollars of military equipment. Annual exports currently run about $100 million and comprise mainly munitions and light naval vessels. Much of this is Korean-designed without U.S. involvement. South Korea's largest markets have been the Middle East, Latin America, and Southeast Asia. This distribution is similar, on a smaller scale, to the markets of the principal Western suppliers of arms, the United States, and Western European countries. South Korean firms have been able to gain markets through competitive prices based partly on lower labor costs. Korean firms also adopted high quality-control standards for their hardware. Moreover, the government has not imposed significant foreign policy restraints on sales to specific countries (human rights, arms control, and conflict limitation constraints, for example).[5]

The emphasis on exports stems from the problem of maintaining a profitable defense industry. South Korean defense firms have operated at below 60 percent of capacity for most of the period after 1984. Government procurement has not been sufficient to bring about a more efficient use of production capacity, a situation that will continue, especially since the emergence of a more democratic political system in 1987 has produced political pressures on the government to spend more in the civilian sectors and restrain defense budget increases. The 1991 defense budget contains much higher rates of spending increases for social welfare, infrastructure, and the environment than for defense.

Figure 8-2—South Korean Arms Imports and Exports, 1978-88



SOURCE: Office of Technology Assessment, from data in U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

Herein lies the pressure to export, either as suppliers of components and parts to Western defense firms or as suppliers of entire weapon systems to developing countries. Foreign participation would enhance the range of potential arms exports, and the involvement of American firms in coproduction would help break down U.S. defense industry opposition to the overseas sales of U.S.-designed weapons and equipment from South Korea. South Korean arms exports have fallen dramatically over the past several years (see figure 8-2).

South Korea's inducement to U.S. firms is the prospect of a more competitive position in the world arms market through coproduction of weapons with Korean industries. South Korean officials cite lower Korean production costs, which will become increasingly important as the world arms market shrinks in the 1990s, especially if European and

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[4] Republic of Korea, Ministry of National Defense, "Defense White Paper 1989," p. 167.

[5] Moon and Baek, op. cit., footnote 1, pp. 25-29.

Chinese arms manufacturers are able to cut into traditional U.S. markets in Southeast Asia, Latin America, and the Middle East. According to South Korean spokesmen, U.S. firms would control the export marketing of weapons manufactured inside South Korea under coproduction deals.[6]

Technology cooperation in weapons development is the third element in South Korea's partnership strategy. R.O.K. Government and industry spokesmen have stated that South Korea needs to produce more sophisticated military equipment in the future. They have spoken of aircraft, missiles, telecommunications equipment, and electronics.[7] In order to achieve this, they believe that future Korean-U.S. industry cooperation should involve increasing levels of technology transfer from U.S. companies to their Korean partners. Korean officials describe several ways for this to come about.

First, there would be established coproduction arrangements under which U.S. companies would provide Korean firms with more sophisticated technology. In U.S.-R.O.K. negotiations over coproduction of the F/A-18 fighter, South Korean officials reportedly pressed for technology for the radar system, certain composite materials, computer software, and high-heat tolerant parts of the engine. South Korea's recent decision to switch to General Dynamics (GD) and its F-16 fighter stem in part from attractive technology transfer terms offered on advanced radar and the Advanced Medium Range Air-to-Air Missile (AMRAAM).

Technology transfer constituted an important consideration in the South Korean Government's initial decisions regarding coproduction of an advanced fighter plane. The government's initial selection of the U.S. F/A-18 fighter over the F-16 had a military rationale (the South Korean Air Force reportedly favored the F/A-18 because of maneuverability and armaments), and the government at that time viewed McDonnell Douglas as better suited to assist South Korea's aerospace industry than GD.

McDonnell Douglas reportedly expanded its technology transfer offers after the South Korean Government ordered a review of the F/A-18 coproduction deal in October 1990. The government ordered the review in reaction to McDonnell Douglas' notification that it had to raise the cost of the project from below $5 billion to about $6.2 billion. The U.S. company reportedly offered expanded Korean participation in McDonnell Douglas' civilian production of jet aircraft. This would have included not only increased subcontracting but also equity participation in a joint venture to produce the MD-12, a priority commercial jetliner project.

These concessions were apparently not enough to satisfy the South Korean Government at the new price. General Dynamics reportedly has offered the same type of technology transfer package, but for only $5.2 billion. In addition, the unit cost of the F-16 is only about $18.4 million, compared to $30.8 million for the F/A-18, a cost difference that will enable South Korea to buy an extra 25 airplanes.[8]

Korean industry spokesmen view the role of the U.S. prime contractor as assisting South Korean participants in the fighter project to design and plan future aircraft. An official of Samsung Aerospace Co., the main South Korean participant in the F/A-18 project, stated that the U.S. partner will be asked to assist Samsung in designing an "interim aircraft," which could be a light transport aircraft, a helicopter, or a subsonic jet trainer.[9] General Dynamics has agreed to provide similar assistance in codeveloping a Korean jet trainer.

The Samsung official also gave a broader set of objectives in the development of an aerospace industry: reaching parity with the developed countries in the manufacture of airframes and engines by the early part of the 21st century, and reaching parity some time after that in the manufacture of avionics and other specialized systems and in the development of advanced systems.[10] He also made clear that government, industry, and the scientific community would work together to reach these goals.

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[6] Park Young-koon, "ROK-U.S. Defense Industry Cooperation—Past Achievements and Future Tasks," paper presented at the Fourth ROK/U.S. Defense Industry Conference, Jan. 16, 1990, p. 5.

[7] Ibid.

[8] Rick Wartzman and Damon Darlin, "South Korea, in a Reversal, Picks F-16 Jet," *The Wall Street Journal*, Mar. 29, 1991, p. A3.

[9] Kim Dhoe-su, "ROK-U.S. Cooperative Programs: KFP and HX," paper presented at the Fourth ROK-U.S. Defense Industry Conference, Jan. 16, 1990, pp. 13-14.

[10] Ibid., pp. 12-13.

Second, joint R&D of new weapons or weapons-related technology would be promoted. In 1988, the United States and South Korea signed a Memorandum of Understanding (MOU) on Defense Technological/Industrial Cooperation. In 1989, Washington and Seoul signed a second MOU for cooperative R&D in missile guidance technology in the development of short-range surface-to-air missiles. This is the first joint R&D program in defense between the two countries.

South Korea's long-term aim is to draw U.S. defense industries into cooperative R&D with Korean firms. Under the F/A-18 coproduction agreement, South Korean industry engineers would have received training at McDonnell Douglas research centers, and McDonnell Douglas engineers would have worked in Korea with the Korean firms involved in the project.[11] Though contract details have not yet been made public, GD will likely pursue similar arrangements.

The South Koreans are aware that U.S. private companies carry out much sophisticated defense-related research in the United States and thus would be an invaluable resource to draw on in developing new weapon systems. The direct participation of U.S. firms would boost the R&D capabilities of South Korean firms substantially. Korean scientists and engineers could gain access to U.S. laboratories and production facilities that they currently do not have.

From the South Korean perspective, collaboration in defense R&D would result in both a higher level of technology in future U.S.-R.O.K. coproduction arrangements and increasing interoperability between the two countries in components and parts. It also could enhance the cooperative export strategy advocated by R.O.K. Government and industry officials.

Third, the South Koreans envisage coproduction of the F-16 fighter and other modern systems as enhancing the ability of Korean companies to provide full maintenance of such weapons. This capability would increase if the South Koreans had knowledge of the technology of such systems. The South Koreans have a strong national security motive for seeking an independent maintenance capability. Korean officials believe that South Korea's current dependence on the U.S. military for maintenance would leave it vulnerable to equipment failures if the United States withdrew its troops from South Korea.

ISSUES FOR THE FUTURE

South Korea's Technological Capabilities

South Korea's technological capabilities in defense appear to lag considerably behind those of Japan and the Western European countries. (Design and construction of naval vessels is probably the single exception.) In general, the gap in defense technology appears to be larger than in the civil industries. In civil technology, South Korean companies have benefited from inflows of technology from Japanese firms in electronics, steel, metals, and automobiles.[12]

The most advanced weapons produced in South Korea suggest the limits of South Korean defense technology. With the exception of naval vessels, none represent original Korean-designed systems, although the government's Agency for Defense Development has succeeded in modifying several U.S. weapon systems. The bulk of weapons produced in South Korea are assemblies of U.S. or other foreign components.

The highly touted Korean K-1 main battle tank is an assemblage of components produced in the United States, Germany, and France. The components are relatively advanced, and the South Koreans have integrated them in the planning and production stages in a relatively short amount of time. Nevertheless, even this most sophisticated of South Korean weapons had no original research and development.[13]

The same situation will likely prevail in the coproduction of the F-16 fighter. If the previous F/A-18 arrangement is any guide, South Korea will purchase about 85 percent of the components of the F-16 from the United States, including the most advanced components. Korean firms will produce the remainder, but some of these are components already used in the U.S. version of the F-16.

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[11] Sin-Yong-su, "Korea's Aerospace Industry," *Korea Herald*, Feb. 11, 1990.

[12] Nanshi Matsuura, "Management Conflict and Foreign Direct Investment: The Case of Japanese Investment in South Korea," *Columbia Journal of World Business*, summer 1989, pp. 61-67.

[13] Brig. Gen. John C. Bahnsen, "Koreans Build Armor Force While U.S. Army Fights Red Tape," *Armed Forces Journal*, May 1988, pp. 58-62.

South Korea's push to acquire more foreign defense technology coincides with a slowing of civilian technology transfer by Japan and other countries. The government responded in 1990 by announcing a $40 billion, 5-year (1990-94) program to develop research institutions in companies and universities for developing new materials, microelectronics, bioengineering, fine chemicals, optics, and aircraft. The goal of the program is to raise production in these fields from $14 billion in 1987 to $50 billion in 1994 and $140 billion by the year 2000.

Although this program aims primarily at the development of these technologies for civilian purposes, it could in time enhance South Korea's military technology in missile guidance, communications and intelligence gathering, computer fire control systems, and materials used in aircraft, tanks, and transport equipment.

Most major South Korean corporations have established new civilian research centers since 1986. To date, civilian-related research has had little application to weapons development; but if the government's technology plan comes to fruition in the 1990, linkage likely will emerge, though gradually. The chaebol now are giving more priority to military-related research, which was neglected until now because of the low profitability of defense business. The Ministry of Defense likely will fund industry and university research on the development of new materials for the aerospace industry and possibly other industries.[14]

The high-technology program and the government's new emphasis on military R&D by Korean firms may indicate that South Korea is prepared to "go it alone" in developing military-related technology in the 1990s, if foreign technology is not available or is denied. If the high-technology program is successful (there are skeptics who believe the government is overreaching), South Korea's conditions for foreign entrance into the defense business will rise accordingly.

In addition to the progress of this program, two other factors will exert major influence on South Korea's defense industrial policy: the emergence of Western European firms as potential participants in South Korea's defense industry and U.S. policy on defense industrial cooperation.

Western European Competition

French, British, German, and Italian defense firms have emerged as competitors to American companies in South Korea's defense market. They are receiving strong support from their respective governments, whose officials have visited Seoul in the last 4 years promoting sales and coproduction.

U.S. military officials in South Korea and U.S. officials in Washington acknowledge that the Europeans are offering South Korea more generous terms than those offered by U.S. companies and the U.S. Government. The Europeans are proposing coproduction deals with extensive technology transfer that, according to these officials, would enable South Korean firms to manufacture a high percentage of components. The Europeans also impose fewer restrictions on South Korea exporting European-designed equipment to third countries than does the United States, and they reportedly offer more generous offsets for South Korean purchases of European weapons and systems.

These initiatives have resulted in several major European sales to South Korea in the last 2 years. South Korea recently announced that it would purchase five or six submarines from Germany. South Korea purchased several European-made components for the K-1 tank. The French have good prospects for business in antisubmarine aircraft, light helicopters, and surface-to-air missiles and other items under an agreement Seoul and Paris plan to sign in 1991.

The South Korean Government has shown particular interest in the European-built Tornado fighter, and there reportedly are discussions between South Korean and German officials over a possible deal. The government's view apparently is not to substitute the Tornado for a U.S. model for production of the Korean Fighter Plane. Rather, the government reportedly wants a squadron of strike aircraft that would have the electronic equipment capable of nighttime and precision attacks on North Korean targets. The Tornado could fit that requirement.

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[14] Bob Johnstone, "Seoul vs. Heavy Metal," *Far Eastern Economic Review*, Aug. 3, 1989, p. 54.

R.O.K. interest in the Tornado mounted after the South Korean Air Force determined that the U.S. F-16 did not have adequate nighttime strike mission capabilities. This led the government to cease consideration of a retaliatory air strike against North Korea for Pyongyang's blowing up of a South Korean airliner in 1987.

Germany has shown greater interest in doing business with South Korea over the Tornado since October 1990, including an offer to train R.O.K. pilots in using the plane's electronic warfare systems and providing South Korea with classified data on the systems. The R.O.K. Government at this stage reportedly has not decided finally to seek the Tornado, and the Germans have made no definite offer of the aircraft and technology. Nevertheless, the Korean Government's view of its mission requirement likely will grow if North Korea is, as reported, constructing a nuclear facility capable of producing atomic bombs by 1994. This, coupled with the apparent inadequacy of U.S.-provided aircraft to meet the requirement of an electronic warfare strike aircraft, soon may give Germany an opportunity to break into a South Korean weapons market in which the United States has had a monopoly for nearly 40 years.

South Korean purchases of European military equipment totaled about $300 million in 1989. It is expected to reach at least $500 million by 1995. This estimate depends on South Korea continuing to give a general preference to the United States in defense business. Given the array of weapons that the Western Europeans could offer South Korea, European sales could climb above this estimate if Seoul decided to accelerate business with European firms. South Korean officials and U.S. military officials in Korea stated in interviews that younger R.O.K. officers and Defense Ministry officials are attracted by European proposals and are pressing the government to shift more defense business away from the United States and to the Europeans.

U.S. Policy

The South Korean Government and defense industry can be expected to encourage Western European offers of defense industrial cooperation and likely will select European bidders for certain high-value military hardware. In addition to obtaining attractive terms from the Western European firms, the South Koreans no doubt will try to use European competition to pressure U.S. firms and the U.S. Government to be more forthcoming in their terms for sales and coproduction.

South Korean Government and industry spokesmen that OTA interviewed in Seoul were critical of U.S. policy on defense industrial cooperation. They charge that the United States is stingy in sharing military-related technology and has added new restrictions on technology transfer. They allege that U.S. firms provide little help in giving Korean firms repair and maintenance capabilities. R.O.K. officials also criticize U.S. restrictions on offsets as imposing higher limitations on offset arrangements with Korean firms than on Western European firms that coproduce U.S. military equipment. They assert that U.S. "Buy American" regulations prevent South Korean companies from subcontracting for components for U.S. defense firms producing weapons for the U.S. Department of Defense. They note that the U.S. Government has exempted 18 other countries from these restrictions but not South Korea.

The South Koreans also accuse the U.S. Government of limiting sales of American fighter aircraft and other weapons systems to equipment that is inferior to systems sold to the NATO countries. South Korean Air Force officers point to two deficiencies of the R.O.K. version of the F-15: the absence of low altitude navigation and targeting infrared equipment for nighttime missions, and the absence of the U.S. Sparrow air-to-air missile with its electronic guidance system. The R.O.K. version of the F-15 does not have the mounting platform for the Sparrow. The South Korean Air Force, therefore, must use the older, heat-seeking Sidewinder missile. The absence of the nighttime mission equipment would restrict South Korea from launching selective air strikes against North Korea.

The South Korean press increasingly echoes these and other complaints. A feature article in the Seoul daily *Tong-A Ilbo* cited U.S. State Department statistics reputedly showing that offsets to Korean companies for the purchase of American military equipment from 1980 through 1987 amounted to 46 percent of the value of the sales compared to 105 percent for Great Britain, 78 percent for Canada, and 133 percent for Spain.[15] (The same figures, however, showed a 48-percent average offset sales percentage for all NATO countries, only slightly above the percentage for South Korea.)

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[15] Pang Hyong-nam, "Korea Purchases From the United States Under Unfavorable Terms," *Tong-A Ilbo*, Apr. 24, 1990.

U.S. officials in Seoul and Washington acknowledged in interviews that many of the South Korean allegations were factual. U.S. military officials in Seoul stated that the missiles and radar systems in F-16 fighters recently sold to South Korea were out-of-date models or inferior to the missiles and radar systems of F-16s sold to NATO allies. U.S. officials also asserted that the U.S. Government was tightening restrictions on the transfer of military-related technology. They cited the denial of key R.O.K. requests for technology in the F/A-18 negotiations and the repeated refusal of South Korean requests for technical data for the 105 mm gun used on U.S. tanks. The U.S. insistence on no more than a 30-percent offset arrangement in the F/A-18 negotiations also showed an apparent tightening of U.S. terms.

The R.O.K. and U.S. Governments have been at odds since the early 1980s over South Korea's desire to export weapons and military equipment produced under U.S. licenses. U.S. law requires State Department approval before South Korea exports military equipment manufactured under U.S. licenses or coproduction arrangements. Over some periods, the State Department has denied more than 50 percent of South Korean applications for third country exports. Knowledgeable U.S. military officials in South Korea stated in May 1990 interviews that, in the last 2 years, the State Department had approved all but one R.O.K. application for export but that the single denial constituted nearly 40 percent of the monetary value of all the applications.

U.S. officials cite several factors behind the increase in restrictions: pressure from Congress for tougher terms; reluctance to share advanced technology because of South Korea's poor record on protecting intellectual property rights; fear of competition from Korean exporters to U.S. arms sales to third countries; and an unwillingness to relax "Buy American" regulations on the purchase of components by American defense firms until South Korea opens its domestic market further to U.S. civilian products.

On strictly economic criteria, U.S. restrictions and growing competition from Western Europe likely would lead to a U.S. loss of defense business with South Korea. However, economic considerations currently are countered by the security ties between the United States and South Korea, the result of the formidable military threat from North Korea. North Korea possesses forces of over 1 million, an army of over 800,000 troops, 540,000 reserves that can be mobilized within 12 hours, 3,500 tanks, and over 4,000 heavy artillery pieces and rocket launchers. The bulk of North Korean ground and air forces are positioned near the demilitarized zone separating the two Koreas. The location of Seoul, only 30 miles south of the demilitarized zone, complicates South Korea's defense problems.

The R.O.K. Government continues to seek an American military presence in South Korea as a counterweight and deterrent to North Korea. The U.S. defense commitment and the presence of over 40,000 American troops in South Korea put pressure on the South Korean Government to buy American military equipment. After voicing their complaints about U.S. restrictions, South Korean officials acknowledge that these considerations create a preference for defense industrial cooperation with the United States. U.S. officials assert that they exploit the security angle in pressuring the South Koreans to choose American firms and weapon systems in procurement decisions. It is uncertain whether the U.S. security advantage will continue throughout the 1990s. The North Korean threat may remain at least until President Kim Il-sung dies. There are no plans at present to remove all U.S. troops, despite the modest reductions in force strength recently announced by the U.S. Defense Department. Nevertheless, the security situation has changed. North Korea increasingly is isolated as the Soviet Union and Eastern European Governments normalize relations with South Korea. The regime apparently has undergone a series of policy debates over how to adjust to the loss of support from allies and how to respond to South Korea's proposals for broadened contacts. The regime has agreed to negotiations between the two Korean prime ministers and talks with Japan on normalization of relations.

These moves may only be tactical, but the pressures on Pyongyang open possibilities for real change in South Korea-North Korea relations. A breakthrough would affect South Korea's defense industrial policy in three ways. First, the rate of defense spending increases probably would fall, reducing acquisitions of foreign arms. Second, the United States probably would withdraw most or all of its forces. Third, economic considerations would gain and security considerations would decline in South Korea's decisions regarding U.S.-Western European competition for defense business.

Looking beyond an end to the North Korean threat, Korea (whether reunified or not) is likely to retain a sizable, well-armed military. Korea will remain surrounded geographically by three big powers—China, Japan, and the Soviet Union—all of which historically have had aggressive designs on Korea. Security factors thus will weigh heavily in foreign policy. Thus, Korea could have a long-term interest in defense industrial collaboration with the United States, especially if the two countries continue to be aligned.

Current U.S. policies do not detract from doing defense business with South Korea so long as security considerations are paramount in overall R.O.K. policies toward the United States. If security factors decline in the wake of a relaxation of Seoul-Pyongyang tensions, U.S. policies could be detrimental to future collaboration. The United States would have to offer economically competitive terms, which it apparently does not do compared with current Western European proposals.

In the future the United States may have to decide how important U.S. involvement in defense business in South Korea is. The debate over the proposed F/A-18 coproduction illustrates this policy issue, because South Korea, with technologically developing industries and relatively low production costs, could be a prime target of any future internationalization of the U.S. defense industry. Proponents of both the F/A-18 and F-16 deals assert that the prospects of declining U.S. defense budgets make cooperative deals with foreign companies necessary for the financial health of the U.S. military aircraft industry.[16] They warn that South Korea may turn to European aircraft producers if U.S. collaboration on fighter aircraft does not materialize.

Critics of these deals argue that the proponents may underestimate South Korea's ability to develop an indigenous fighter by the end of the century if it is able to draw on the technology and production know-how of an advanced U.S. fighter manufacturer. They also assert that even an inferior South Korean indigenous fighter could cut into U.S. markets in developing countries because of lower prices.

The proponents and critics have clashed, too, on the issue of the U.S. aircraft industry's role in the globalization of aircraft production into the 21st century. In the case of South Korea, critics accuse U.S. firms of being willing to help that country develop a full-fledged defense and aerospace industry, first by producing parts for aircraft and other weapons systems manufactured in the United States and then by producing aircraft and other weapons in South Korea itself. McDonnell Douglas and General Dynamics may represent the view of other major American defense companies when they assert that U.S. companies must be involved in the globalization of weapons production. They cite profits to be gained from such assistance to countries like South Korea (in contrast to a likely shrinking U.S. market) and cost reductions from shifting the production of components to countries like South Korea.

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[16] Jeff Shear, "Congress Huffs, Puffs as Seoul Seeks to Build Fighter Planes," *Washington Times*, Oct. 12, 1989.

Chapter 9

The Defense Industry of Brazil

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Chapter 9

The Defense Industry of Brazil

PRODUCTION FOR EXPORT

Brazil emerged in the mid-1980s as the leading arms producer and exporter among the defense industrializing countries, and the sixth largest arms exporter in the world. The Iran-Iraq War, in particular, stimulated arms exports by Brazilian defense companies. Iraq has been Brazil's largest customer, purchasing armored personnel carriers, missiles, and aircraft, often in exchange for oil (see table 9-1).

The termination of hostilities between the two Persian Gulf rivals in 1988 has had a debilitating effect on two Brazilian companies, Avibras and Engesa.[1] Both companies are in financial crisis, despite the conclusion in 1988 of a major arms deal with Libya. The arms embargo against Iraq has further weakened the ability of Brazil to maintain its defense industrial base at 1980s production levels. Not only are Brazilian companies prohibited from exporting to their favored customer, but negotiations for the proposed sale to Saudi Arabia of Engesa's Osorio main battle tank (an estimated $7 billion contract) remain suspended.

Clearly the vulnerability of Brazil's arms industries to fluctuations in the international arms trade tempers the success of the Brazilian defense industrial model. Nonetheless, of the leading developing arms producers (Brazil, India, and South Korea), Brazil's defense industry is the most self-sufficient. Brazil's major defense firms have substantial R&D and production capability, aided by strategic inputs of foreign technology, often through joint ventures.[2]

The role of various Brazilian governments in the development of an indigenous arms industry is an indirect one. Due to budgetary constraints deriving from massive foreign debt, the government has provided little support for these industries through domestic defense procurement. Brazil's defense expenditures over the past 20 years have been relatively insignificant, averaging 1.3 percent of gross domestic product per year (see figure 9-1). As a result, the government has used various fiscal incentives and trade policies to promote an economic environment in which these firms may operate.[3] The most direct form of government support is to encourage linkage between the research institutes of the armed forces and the respective industries: the Aerospace Technical Center (CTA) for the aircraft and missile-related companies, the Army Technical Center (CTE$_x$) for the armored vehicle industries, and the Naval Research Center (CP$_q$M) for the naval sector.

In contrast to other developing nations, state ownership of defense industries in Brazil is negligible. With the partial exception of Embraer (a mixed company 51 percent owned by the Air Force and 49 percent by private-sector shareholders), Brazil's defense firms are located in the private transportation and capital goods sectors. The defense sector is diversified in its R&D and production capabilities and includes advanced fighter aircraft, main battle tanks, nuclear-powered submarines, and missiles. Although there are over 500 manufacturers of defense-related equipment, three firms have been largely responsible for Brazilian defense exports: in aircraft, Embraer; in armored fighting vehicles, Engesa; and in missiles, Avibras.[4]

AIRCRAFT

The rise of Embraer (Empresa Brasileira da Aeronautica S.A.) from a fledgling company of 595 employees in 1970 to the world's fifth largest aircraft manufacturer has been charted by industry observers and defense academicians alike. The evolution of Brazil's aircraft industry has been driven largely by Embraer's concern for profitability and technological learning.[5] Specifically, the indus-

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[1] James Brooke, "Gulf Crisis Has Brazil in a Tailspin," *The New York Times*, Aug. 27, 1990.

[2] For an analysis of Brazil's defense industry see Carol Evans, *Defense Production in the NICs: Case Studies From Brazil and India* (London: The London School of Economics, spring 1991), passim.

[3] See Patrice Franko Jones, "Public Private Partnership: Lessons From the Brazilian Armaments Industry," *Journal of Interamerican Studies and World Affairs*, vol. 29, winter 1987-88.

[4] See Clovis Brigagad, *O Mercado do Seguranca: Ensaio Sobre Economia Politica* (Rio de Janeiro: Editora Nova Fronteira, 1984).

[5] Renato Dagnino, "A Industria de Armamentos Brasileira: Desenvolvimento e Perspectivas," *O Armentismo e o Brasil: A Guerra Deles* (Sao Paulo: Editora Brasiliemse S.A., 1985), pp. 75-105.

Table 9-1—Brazilian Arms Exports, 1977-88

Country	Number ordered*	Weapon system	Year ordered	Delivered*
Abu Dhabi	200	EE-9 Cascavel armored car	1977	
Algeria	2	EMB-111 marine patrol aircraft	1982	2
		EE-9 Cascavel armored car	1985	
Angola	2	EMB-111 marine patrol aircraft	1988	2
Argentina	30	EMB-312 Tucano trainer	1987-88	30
Belgium	5	EMB-121 Xingu transport	1982	
Bolivia	3	HB-315B Gavaio helicopter	1984	3
		HB-315B Gavaio helicopter	1987-88	3
	40	Neiva T-25 Universal	1977	
Canada		EMB-312 Tucano trainer	1983	
Chile	2	EMB-120 Brasilia transport	1982	
	10	Anchova-class patrol craft	1980-81	10
	50	EE-11 Urutu armored personnel carrier	1981	50
	40	EE-17 Sucuri tank destroyer	1981	40
	6	EMB 126 Xavante transport/counter-insurgency	1978	
	20	T-25 Universal Neiva	1979	
	6	EMB-111 Bandeirante	1977	3
	10	Macharen fast patrol craft	1977	
Colombia	14	EMB-126 Xavante transport/counter-insurgency	1982	
Cyprus	120	EE-3 Jararaca scout car	1984-88	120
	120	EE-9 Cascavel armored car	1984-88	120
	20	EE-9 Cascavel armored car	1984	20
Ecuador	10	EMB-312 Tucano trainer	1983	
Egypt	110	EMB-312 Tucano trainer	1983	12
		(licensed production: 30 for Egypt, 80 for Iraq under a Saudi-financed, $180 million loan)	1986	48
France	41	EMB-121 Xingu transport	1981-84	8
	20	EMB-312 Tucano trainer	1988	
		(contingent order for up to 150 based on reciprocal helicopter purchase by Brazil)		
Gabon		EMB-111 marine patrol aircraft	1981	1
		EE-9 Cascavel armored car	1981	6
	16	EE-11 Urutu armored personnel carrier	1983-84	16
Guyana	1	EMB-110 Bandeirante transport	1985	1
	1	Model-412 helicopter	1985	1
	30	EE-11 Urutu armored personnel carrier	1984	30
Honduras	12	EMB-312 trainer	1984-85	12
Iraq	300	EE-3 Jararaca scout car	1984-85	300
	250	EE-9 Cascavel armored car	1987-88	200
	80	EMB-312 Tucano trainer	1985	20
	200	EE-3 Jararaca scout car	1987	
	38	Astros II SS-30 multiple rocket launcher	1985-87	38
	20	Astros II SS-60 multiple rocket launcher	1981-88	20
	13	Astros II guidance and fire control system	1984-88	13
	640	SS-60 surface-to-surface missiles	1987-88	640
	150	EE-11 Urutu armored personnel carrier	1979-81	150
	150	EE-17 Sucuri tank destroyer	1979-81	250
	750	EE-9 Cascavel armored car	1979-81	750
		MAS-1 Carcara air-to-surface missile	1981	
Iran	50	EMB-312 Tucano trainer	1988	

*Blanks indicate data not publicly available.

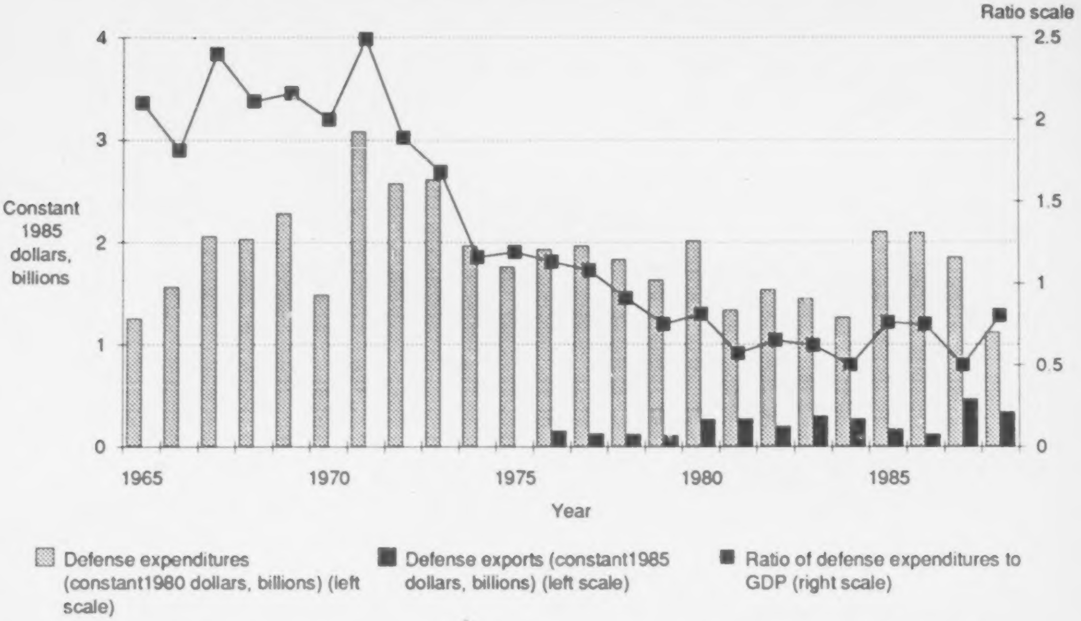
Table 9-1—Continued

Country	Number ordered*	Weapon system	Year ordered	Delivered*
Libya	8	EMB-111 marine patrol aircraft	1986	
	25	EMB-121 Xingu transport	1986	
	100	EMB-312 Tucano trainer	1986	
	100	X-2 180mm multiple rocket system	1987	50
		EE-11 Urutu armored personnel carrier	1986	
		EE-9 Cascavel armored car	1986	
		EE-T1 Osorio main battle tank	1986	
	200	EE-9 Cascavel armored car	1978	200
		Astros II SS-40 multiple rocket launcher	1986-88	30
		Astros II SS-60 multiple rocket launcher	1987	15
		EE-3 Jararaca scout car	1987	
	3	Astros II guidance and fire control system (denied by Brazilian government)	1987-88	3
	450	SS-60 surface-to-surface missile	1987-88	450
Madagascar		EMB-111 maritime patrol aircraft	1981	
Morocco	60	EE-11 Urutu armored personnel carrier (17 on loan from Libya prior to delivery)	1986-87	60
Nigeria	50	EMB-312 Tucano trainer	1986	
	100	EE-9 Cascavel armored car	1986	
	5	EMB-110 Bandierante transport	1986	5
Paraguay	10	EMB-110 Bandierante transport	1985	4
	2	HB-305M Esquilo helicopter (licensed from France)	1985	2
		EE-11 Urutu armored personnel carrier	1984	
		EE-9 Cascavel armored car	1984	
	1	Roranima Class patrol craft	1985	1
	9	Xavante transport/counter-insurgency	1980	3
	12	Uirapura	1979	
Portugal		EE-11 Urutu armored personnel carrier	1981	
		EE-9 Cascavel armored car	1981	
Qatar	20	EE-9 Cascavel armored car	1976-77	10
Saudi Arabia		EE-9 Cascavel armored car	1984	
	30	EE-11 Urutu armored personnel carrier	1985	30
	(2,000)	EE-72 Osorio main battle tank	1985	negotiating
		Astros II SS-30 multiple rocket launcher	1988	10
		Astros II SS-40 multiple rocket launcher	1987-88	30
		Astros II guidance and fire control system	1987-88	4
Sudan	6	EMB-110 Bandeirante transport	1977	3
Suriname		EE-11 Urutu armored personnel carrier	1984	10
Thailand	56	EE-9 Cascavel armored car	1981	56
Tunisia		EE-3 Jararaca scout car	1984	
United Arab Emirates		EE-11 Urutu armored personnel carrier	1985	30
United Kingdom	130	EMB-312 Tucano trainer	1985	licensed production
Upper Volta	1	EMB-110 Bandeirante transport	1981	1
Venezuela	30	EMB-312 Tucano trainer	1986-87	30
	30	EE-11 Urutu armored personnel carrier	1984	30
		EE-3 Jararaca scout car	1984	
	100	EE-11 Urutu armored personnel carrier	1988	
		EMB-312 Tucano trainer	1988	1
Zimbabwe	90	EE-9 Cascavel armored car	1983	10

*Blanks indicate data not publicly available.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Figure 9-1—Brazilian Defense Expenditures and Exports, 1965-88



SOURCE: Office of Technology Assessment, from data in International Institute for Strategic Studies, *The Military Balance* (London: Brassey's, various years) and Stockholm International Peace Research Institute, SIPRI Yearbook, various years, *World Armaments and Disarmament.*

try has developed using four concomitant approaches:

1. commitment to indigenous design and manufacture,
2. joint ventures with foreign aircraft producers to acquire and upgrade technological capabilities,
3. phased introduction of domestic components, and
4. product development balanced between military and civil aircraft for domestic and export markets.[6]

Three planes—the Bandeirante, the Tucano, and the Brasilia—have marked Embraer's indigenous technological advance. The Bandeirante was developed at CTA in response to the general aviation need for a small passenger and freight aircraft, which could operate on the short and often unpaved airstrips characteristic of the country's interior. Although the Bandeirante is primarily configured as a 19-seat aircraft designed for regional passenger and cargo transport, its design is enormously flexible. For example, using the same airframe, the Bandeirante also comes in versions for air drop, search and rescue, maritime surveillance, and ambulance missions.

The export success of the Bandeirante stemmed not only from its design flexibility but also from Embraer's strategy of market segmentation and price competitiveness. For instance, despite its intermediate-level technical sophistication, the Bandeirante was exported to both developed and developing countries. By 1990, 500 units had been produced and were operating in 24 countries, primarily in the United States (over 147 units), and in Brazil itself.[7]

With the success of the Bandeirante, Embraer was able to establish an international reputation in the commuter airline market—a base from which it was well placed to profit from the rapid development of this market segment with its new product, the EMB-120 Brasilia. U.S. carriers presently flying the Brasilia include Texas Air Corp, Britt Airways, and

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[6] Interview with Embraer company official.

[7] Embraer company data.

Air Midwest. The two principal attractions of the Brasilia are its performance (its 300 km cruising speed makes the Brasilia the fastest in its class) and its price and financing package.[8]

With the development of the Tucano turboprop trainer, Embraer's first indigenously designed military aircraft, the company followed its traditional policy of satisfying the domestic requirements of the Brazilian Air Force while targeting an export market niche. With a low price tag of $1.9 million, and over 600 aircraft sold worldwide, the Tucano has become the sales leader in the military turboprop trainer field. The Tucano also was the first military sale by a Brazilian company to a member of NATO. In 1985, the British Royal Air Force selected the Tucano over established domestic and European competitors such as the Swiss Pilatus PC-9 and British Aerospace's Hawk.

COLLABORATIVE PROGRAMS

Embraer has used joint ventures to develop the company's technological capabilities and to offset the risks and costs of new production programs. Among these joint ventures, the AMX fighter and the CBA commuter aircraft programs best illustrate the above strategy.

When Embraer wanted to introduce the Bandeirante's successor, a 19-seat, pressurized pusher-prop commuter aircraft, it sought a major joint venture with Argentina's Fabrica Argentina de Materiales Aerospaciales (FAMA). The cockpit and the fuselage of the Brasilia will be used, and a new engine developed by Garrett—a "twinprop pusher" mounted on the rear—will push the plane as opposed to traditional propeller engines that pull the plane forward.[9] Production and financing is divided: 67 percent for Embraer and 33 percent for FAMA.[10]

The project, which has contributed the most to Embraer's technological development (through spillovers into other products) and the least in terms of profitability, is the AMX collaborative project with Italy's Aeritalia and Aermacchi. The Brazilian company has a 29.7-percent share in the program, while the shares of Aeritalia and Aermacchi are 46.5 and 23.8 percent respectively. The Brazilian Air Force will receive a total order of 79 AMXs to replace the aging Xavantes and Italy's Air Force will take the remaining 187.[11]

Following the pattern of the automotive industry, the aircraft industry is also becoming more interdependent and internationalized, despite its strategic value. Embraer has become a subcontractor to other aircraft industries and has been obliged increasingly to negotiate offset contracts for its exports. Embraer executives argue that offsets are central to ensuring foreign contracts, particularly in the advanced industrialized countries, where rationalization of defense-related industries has had important employment ramifications. This willingness to provide offsets was an important factor securing the sale of the Tucano to the British Royal Air Force. Thirty percent of the aircraft (the wings, landing gear, and canopy) is made in Brazil and 60 percent is fabricated under license from Embraer by Short Brothers in Northern Ireland.[12] The Tucano is also licensed-produced by Egypt, though Embraer produces and ships all of the parts to Egypt for assembly. A more recent subcontract arrangement involves the manufacture by Embraer of 207 advanced composite external wings for McDonnell Douglas' new MD-11 wide-body trijet. This offset is in connection with Varig's proposed purchase of an unspecified number of MD-11 aircraft.[13]

Brazil's economy, with its $120 billion debt and its need for exports, is precisely why Embraer has so heavily favored development of products attractive to its export customers. Embraer also avoided the mistake countries starting aircraft industries (such as India) have made of relying almost exclusively on domestic military procurement. The company has maintained a balance between military and civil aircraft production from the start. In 1987, for example, Embraer exported aircraft worth $320 million, which represented 68.1 percent of total production. Out of the 31.9 percent that constituted domestic sales, the civil market accounted for 25.7

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[8] Brasilia, the capital of the country, is built in the shape of an airplane.

[9] "Embraer Begins Marketing New EMB-123 Version," *Aviation Week and Space Technology*, Oct. 13, 1986, p. 128.

[10] Embraer company data.

[11] Embraer company data.

[12] Interview with Embraer official.

[13] Interview with Embraer official.

percent. International sales are divided 33.4 percent for military and 67.6 percent for civil.[14]

ARMORED VEHICLES

A few years ago, television viewers saw the Colombian army storm the justice ministry in an attempt to dislodge terrorists, who were holding several judges hostage. Visible were several Cascavel armored cars, part of a fleet of 100 purchased in 1981 from Brazil's leading arms export company, Engenheiros Especializados S.A., known as Engesa.

Engesa's meteoric rise from a small equipment and transport producer to a major armored vehicle manufacturer attests to strong private entrepreneurship, product development through linkage to the Brazilian and transnational transport industries, and to government-university research centers, as well as international marketing abilities. Engesa's export performance has been remarkable. The company has exported its armored and reconnaissance vehicles to over 20 countries in the Middle East and Africa. Annual export earnings amounted to over $53 million for the 1977-82 period and $122 million for the 1983-88 period.[15]

In terms of product development, all of Engesa's armored fighting vehicles and armored personnel carriers share the same characteristics: simple and flexible design concepts, low cost, good performance and reliability, ease of use, and simple maintenance. These characteristics are the major selling points of Engesa's products to its customers in the developing countries.[16]

The company's strong engineering and technical base is reinforced through linkages to other military, industrial, and university centers: the Engineering Institute, CTE$_x$, National Research Institute, and the Institute for Research and Technology. Not only has Engesa tapped into available technological developments in related metallurgical, electronics, and chemical industries, but this form of technology sharing also provides a way of selecting highly trained and educated future employees.[17]

Engesa's sales and marketing strategy is pivotal in helping to explain Brazil's success in achieving the number six position among the world's leading defense exporters. The company has had to overcome many barriers to entry in the highly competitive international arms market, not least of which includes lack of export financing (e.g., that provided by the U.S. Foreign Military Financing program) and lack of military and government sales support. Engesa's sales and marketing executives attribute the company's success in export markets to the fact that the company's sales teams are extraordinarily well prepared. "They have assessed the competition and its capabilities, they know Engesa's product capabilities thoroughly, and team members are interoperable in terms of their technical and financial backgrounds."[18] A related factor is the company's well-known after-sales support in terms of guaranteed access to spare parts, training for system operators, and maintenance (including front-line repair during the Iran-Iraq war). Engesa is well positioned to take advantage of Brazil's nonaligned position in the international system and its affinity with other developing nations.[19]

The Osorio main battle tank (MBT) exemplifies the way Engesa approaches development of new weapon systems. First, following the Saudi Arabian requirement for a light main battle tank, the company conducted a market feasibility study of other developing countries, where bridges and roads could not support 60-ton MBTs such as the U.S. M1A1 or the French AMX. Second, Engesa searched for the best available armor, engines, suspension system, electronics, and gears. In keeping with its strategy of finding suppliers who would share the development costs, Engesa succeeded in attracting many international defense equipment suppliers because the Osorio program represented the only new tank development project in the 1980s and 1990s. For example, Dunlop, supplier to the British Challenger I MBT, was willing to provide the Osorio's hydropneumatic suspension system (which keeps the tank lower on the ground than the more conventional torsion bar suspension). Within Brazil, Engesa could rely once more on the transnational automotive industry, particularly West German companies, to supply the smaller 85 km/hr engine and the gear box.[20]

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[14] Data provided by the Commissao Valores Mobilizacao, Rio de Janeiro, 1988-89.

[15] Engesa company data.

[16] See Peter Locke, "Brazil: Arms for Export," *Arms Production in the Third World*, M. Brzoska and T. Ohlson (eds.) (London: Taylor & Francis, 1986).

[17] Interview with technical director of Engesa, August 1989.

[18] Interviews with directors of Engesa's commercial and marketing divisions, August 1989.

[19] Engesa, *Military Products* (Sao Paulo: Engesa, n.d.).

The development of this MBT also reflects the inherent difficulties facing a company based in the developing world in moving up the high-technology ladder to the production of more advanced weapon systems. First, the financial resources required are enormous. Since Saudi Arabia gave the go-ahead for prototype production of the Osorio in 1985, Engesa proceeded to spend $60 million in R&D and prototype development. It had been widely rumored that Saudi Arabia had provided financial assistance for the initial R&D costs. (When asked whether such reports were accurate, company officials said that they had not been able to "recover" the money previously offered.)[21] Despite an announcement in August 1989 by the Saudi Government to buy 318 Osorios (renamed Al Fahd, the Leopard), the contract worth $7.2 billion has yet to be finalized.[22] In April 1990, after laying off 3,000 workers, Engesa filed for bankruptcy protection.

MISSILES

Since the early 1980s, Avibras has been one of Brazil's leading export companies. It is a privately owned Brazilian firm with a reputation for professionalism, a low-profile image, and great autonomy from government agencies as well as from the armed forces. Avibras' activities are concentrated in defense-related areas: space research and satellite communications, rocket and missile development, and electronics and chemistry (propellants and explosives). The company is located in Sao Jose dos Campos in Sao Paulo state, the center of aerospace activity in Brazil.

The company's first project was in space design and research. It was contracted by the CTA's Institute for Space Activity (IAE) and the National Space Research Institute (INPE) to assist in the Sonda I, II, III, and IV experimental sounding rocket and satellite launch vehicle research programs. Avibras contributed its expertise in design, electronics (related to guidance), and propellants (special solid fuels). In addition to these space-related activities, Avibras has developed meteorological radars and satellite communication antennas and their associated Earth stations for the IAE's satellites, which are being launched by the European Space Agency. In this respect Avibras has made possible an important linkage between Brasilsat and Intelsat—the satellite organizations for Brazil and for the world.

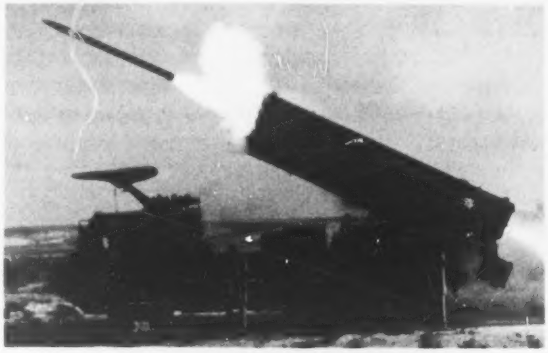

Photo credit: U.S. Department of Defense

The Avibras Artillery Saturation Rocket Bombardment System Astros II multiple rocket launcher deployed by the Royal Saudi Army during the Persian Gulf War. The unit can fire rockets from 9 to 70 km with high explosive and cluster munitions. It is known to be in service in Brazil, Libya, Iraq, and Saudi Arabia.

In addition to its space and communications programs, Avibras is also at the forefront of tactical rocket and missile production among the developing nations. Its most important program is the Astros II (Artillery Saturation Rocket Bombardment System), employed against targets at 9 to 70 km, with rockets of 127mm, 180mm, and 300mm. The latter rocket uses a system consisting of an armored launch vehicle, an ammunition supply, and a fire control vehicle (all manufactured by Avibras' Tectran division). This system was used extensively by Iraq (Avibras' largest customer) during its war with Iran, and by Libya. Avibras also markets air-to-ground missiles and a full line of bombs: napalm, cluster, and runway destruction. In addition, Avibras has assisted in the prototype development of the SM-70 Barracuda coastal defense missile, which is to equip the Navy's corvettes, originally indigenously designed for Exocet capability. It also has developed the SS-300 long-range missile, capable of carrying a nuclear warhead, with a range of 170 miles.

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[20] Company data.

[21] Interview with Engesa commercial/marketing director, August 1989.

[22] Robert Godoy, "Tanque pode render ate U.S. 7 Bilhoes," *O Estado do Sao Paulo*, Aug. 22, 1989, p. 11.

Avibras had the largest export earnings in 1987 of any private Brazilian company: over $340 million as compared to the export earnings of Engesa's $300 million. Over the last 5 years Avibras' exports equaled approximately $700 million.[23] Avibras has had increasing difficulty obtaining the necessary financing for the development of new weapon systems and has sought foreign financing for front-end developmental costs—for instance, the Astros II was funded partially by Iraq, and Libya has provided some financing for the long-range missile program.[24]

ORBITA

Orbita is an association of five aerospace-related companies, which was formed in 1986. It consists of Engesa and Embraer, each with 40 percent participation, with the remainder divided among three companies: Esca, an aerospace company interested primarily in air traffic control and radar systems with 11 percent; Imbel, the Brazilian Army ammunition and propellant factory with 5 percent participation; and Parcom, the splinter group that left D.F. Vasconcelos in 1989 at 4 percent.[25] The association, which at present operates from Engesa's Sao Paulo headquarters (though it is expected to have its own facilities on Embraer's land in Sao Jose dos Campos), is largely a paper company, as none of its three main missile projects—the air-to-air missile MAA-1 Piranha for the AMX aircraft; the surface-to-air missile MSA-31; and the surface-to-surface anti-tank missile MSS-12 have proceeded beyond the prototype development phase.

CONCLUSION

Fueled by the Iran-Iraq War, Brazil's defense exports peaked during the 1978 to 1986 period. A substantial amount of these arms transfers consisted of arms-for-oil transactions.[26] Not surprisingly, Brazil's largest military customers are from the oil-rich Middle East.

Brazil's defense cooperation agreement with Saudi Arabia and Brazilian sales of short-and medium-range missiles to Libya and Iraq have drawn sharp criticism from Washington. Sensitive to the potential impact of nuclear and defense technology proliferation in the region, the U.S. State and Commerce Departments have imposed restrictions on technology transfers to Brazilian defense firms. In response, Brazil's Foreign Ministry has argued that such measures were initiated primarily to prevent the entrance by Brazilian defense firms into the higher technology end of the international arms trade, which has been long dominated by established U.S., Soviet, and European companies.[27]

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[23] Data provided by the Bank of Brazil's Foreign Trade Division, CACEX.

[24] Interview with Avibras company official.

[25] Orbita corporate video presentation, Sao Paulo, November 1988.

[26] Interview with officials from Brazil's Foreign Ministry, Itamaraty, and CACEX, Brasilia, August 1989.

[27] Interview with official from Brazil's Foreign Ministry, Itamaraty, Brasilia, August 1989.

Chapter 10

The Defense Industry of India

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Chapter 10

The Defense Industry of India

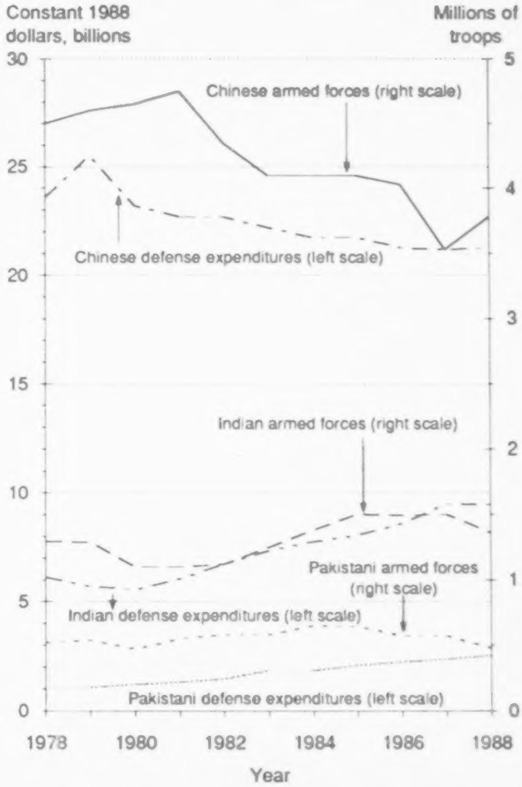
INTRODUCTION

India's military industrial complex is one of the oldest, largest, and most diversified in the developing world. The expansion of India's defense industrial capacity, particularly in the 1980s, was largely conditioned by the South Asian arms build-up among China, Pakistan, and India (see figure 10-1). The growth of the Indian arms industries was fueled both by increases in domestic defense spending, which increased from $5.5 billion in 1980 to $9.5 billion in 1989, and by foreign military aid and arms transfers. Pakistan's receipt of $1.6 billion in U.S. military assistance (1982-87), including the acquisition of the F-16, was met by India's acceptance of a $1.74 billion arms transfer (1988-93) from the Soviet Union, which included licensed production of the Soviet T-72 tank, MiG-23 interceptor, and the MiG-29 Fulcrum.[1] India was the third largest recipient of arms transfers in the developing world during the 1985-89 period and the largest nonoil-producing arms importer (see figure 10-2).

Indian defense officials have also argued that the growing superpower presence in the Indian Ocean was a factor motivating its arms build-up, including the experience during the 1971 India-Pakistan War, when the *U.S.S. Enterprise* was deployed in the Bay of Bengal. The introduction of sophisticated arms to the region is also cited as a stimulus for increased domestic production of weapon systems. India's enhanced naval capability, which includes submarines and aircraft carriers, has already affected two of the region's six island states, the Maldives and Sri Lanka. Indian forces suppressed a coup against the government of President Gayoom of the Maldives in November 1988, and India continues to frustrate Sri Lanka's efforts to suppress its Tamil separatist guerrillas.

To secure its strategic objectives, the Indian Government has established a large scale defense industrial sector that includes 9 state-owned defense industries, 33 ordnance factories, and 34 R&D establishments and laboratories. The long-term goal has been to build an indigenous defense industrial base, capable of supplying a wide range of advanced defense equipment.

Figure 10-1—South Asia Defense Expenditures and Military Force Levels, 1978-88



SOURCE: Office of Technology Assessment, from data in U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

India's policy of self-reliance in defense production has been complemented by imports of sophisticated weapon systems and related technologies primarily from the Soviet Union (see figures 10-3 and 10-4 on Indian arms imports and figures 10-5 and 10-6 on Indian licensed production activities). The partial success of this strategy is reflected by India's advanced production capabilities (for a

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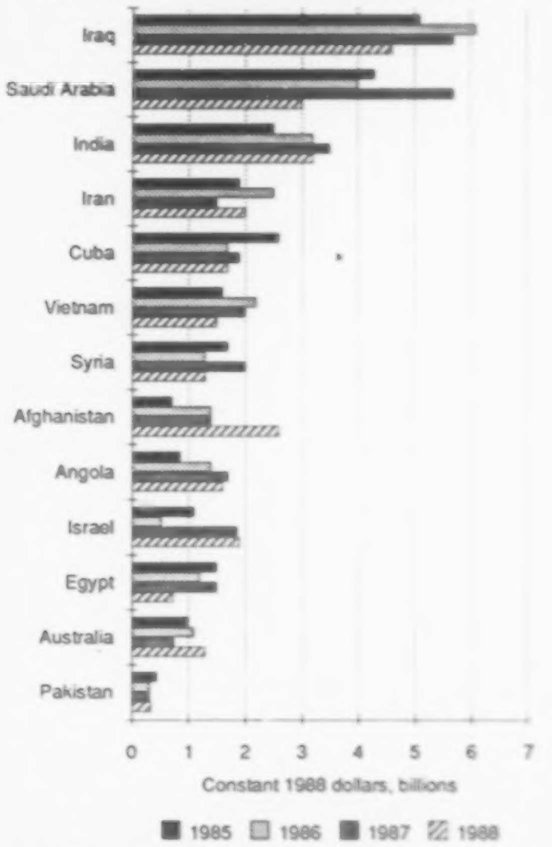
[1] See Ron Mathews, *Defence Production in India* (New Delhi: ABC Publishers, 1989).

Figure 10-2—Leading Arms Importers, 1985-88



SOURCE: Office of Technology Assessment, from data in U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

developing nation) in all weapons categories: jet fighters, aircraft, and helicopters; main battle tanks and armored personnel carriers; diesel-powered submarines and frigates; ballistic missiles; electronic and communication equipment; and small arms, artillery, and ammunition.

However, the Indian defense industries remain dependent on foreign technology, particularly systems produced under license from the Soviet Union. In this regard, the mixed experience of India's defense industrialization demonstrates that successive licensed production of sophisticated weapon systems augments but does not guarantee the transition to independent local design and production. Over the past four decades, India's defense production program has suffered from the relative isolation of defense-related production activities. There is little technology spillover into the private manufacturing sector, and civil industrial input to defense production is negligible.

Since 1985 the Indian Government has encouraged greater interaction between defense production and civil industry by promoting private sector participation. For instance, a private firm, Kirloskars, is providing the diesel engine for the Arjun main battle tank. The tank's computer is being designed by Nelco and Bharat Electronics Ltd. (BEL) jointly, and Dunlop is supplying the rubber pads for the tank's tracks.

The Indian Government has also attempted to increase exports to offset the foreign exchange burden created by massive arms imports. Such efforts, however, are hampered by lack of international marketing expertise and by restrictive provisions in licensing agreements: for example, India's export of MiG-21 spare parts to Egypt was prohibited by the Soviet Union. India has exported small arms and ammunition to Jordan, Lebanon, and Oman, as well as nonarmored vehicles to Malaysia and Nigeria. The notable foreign sale was the export in 1983 of eight Chetak helicopters to the Soviet Union.[2]

India's Military-Industrial-Research Sector

Central to India's military-industrial-research sector are the nine defense firms and the government's Defense Research and Development Organization (DRDO). The defense firms are administered by the Ministry of Defense; all manufacture weapons and equipment for the armed forces as well as capital goods for the civilian sector. Many of these firms were established by the British during World War II, while others were located in the private sector and subsequently acquired by the government (see table 10-1).

The largest state firm is Hindustan Aircraft Ltd., whose main aerospace production factories are located in Bangalore and Nasik. Another 10 facilities are spread throughout 6 Indian states.

Bharat Electronics Ltd. (BEL) is the second largest defense firm. Sixty percent of its production (radio, radar, and electronics equipment) is for the

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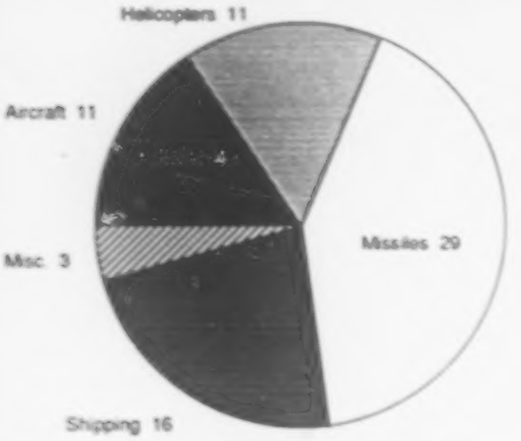
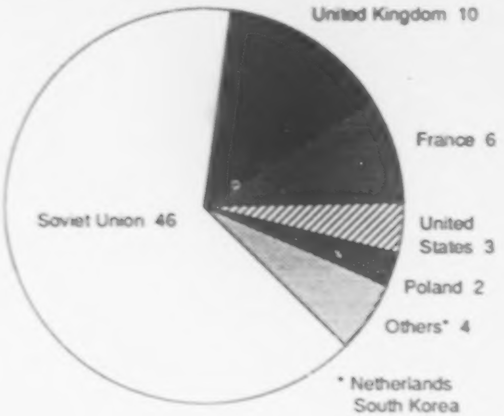
[2] Dilip Mukerjee, "Hi-Tech Players in a Dangerous Game of Catch," *Far Eastern Economic Review*, June 9, 1988.

Figure 10-3—Indian Major Conventional Weapon Import Deals, by Type of Weapon, 1970-90



SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

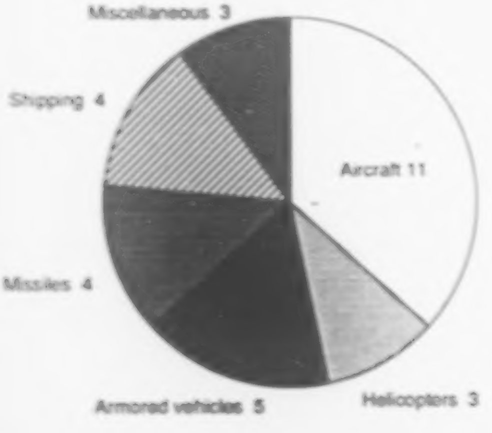
Figure 10-4—Indian Major Conventional Weapon Import Deals, by Country of Origin, 1970-90



* Netherlands
South Korea
Sweden
West Germany

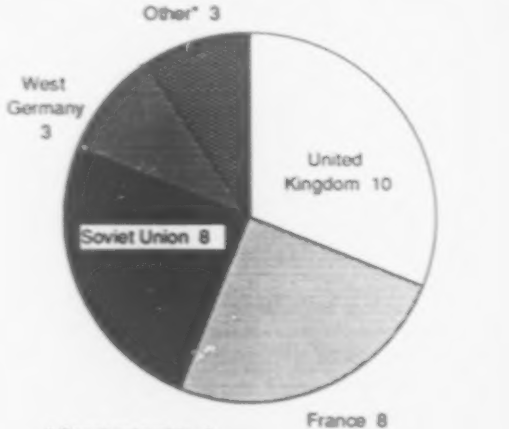
SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Figure 10-5—Indian Licensed Production of Major Conventional Weapons, by Type of Weapon, 1970-90



SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Figure 10-6—Indian Licensed Production of Major Conventional Weapons, by Country of License Origin, 1970-90



* Czechoslovakia 1
Netherlands 1
Switzerland 1

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

armed forces; the remaining 40 percent is destined for the civil market (TV broadcasting equipment and satellite receiver terminals). The third state-owned defense company is Bharai Earth Movers Ltd. (BEML), whose products include transport trailers and earth moving equipment. BEML is the largest exporter of the nine state-owned defense companies.

India's naval sector consists of three shipyards: Magazon Docks Ltd. (MDL), Goa Shipyards, and

Table 10-1—Indian Defense Production, 1987-88 (1988 dollars, millions)

Selected defense firms	Production	Profit before tax	Exports	Employment
Hindustan Aeronautics	546	31.0	0.09	43,833
Bharat Electronics	328	24.0	0.80	19,266
Bharat Earth Movers	431	40.0	35.12	16,151
Magazon Docks	200	28.0	0.00	14,355
Goa Shipyards	14	–.87	0.03	2,091
Garden Reach Shipyards	63	–.77	0.00	10,427
Bharat Dynamics	32	3.0	0.00	1,798
Midhani	22	0.26	0.00	
Total	1,637	124.9	36.04	109,428

SOURCE: Office of Technology Assessment, 1991.

Garden Reach Shipyards. Established in 1774 and acquired by the Ministry of Defense in 1960, MDL is India's preeminent shipyard, capable of building warships such as frigates and submarines, as well as cargo and passenger ships. At present approximately 60 percent of the yard's production is in the civil sector, specializing in ship repair, construction of off-shore oil platforms, and floating docks and cranes. Goa Shipyards Ltd. was acquired in 1964 and is a subsidiary of Magazon Docks. It specializes in ship repair and engineering work. Located in Calcutta, Garden Reach Shipyards is engaged primarily in ship repair and engineering activities, such as the manufacture of air compressors, turbine pumps, diesel engines, and generators. Two-thirds of its production is for the civil sector.

Three relatively small defense firms are engaged in missile production, machine tool manufacturing, and the development of alloys. Bharat Dynamics, Ltd. has produced under license Aérospatiale's SS-11-B1 antitank missile. Praya Tools, Ltd. manufactures machine tools as well as castings and forgings used in defense production. Mishra Dhata Nigam Ltd. (MDNL) was established in 1973 principally to reduce India's dependence on imported specialized metals (titanium and tungsten) and alloys for fabricating components for the nuclear and aerospace industries. It has received significant foreign assistance from France (Creuset Loire and Perchiney-Ugine Kuhlman) and from West Germany (Krupp).

Unlike many other defense producers among the newly industrializing countries, India has invested heavily in its defense R&D base to achieve greater self-sufficiency in defense production, and to reduce imports of foreign technologies. Under the Ministry of Defense, the Defense Research and Development Organization operates 42 major laboratories and employs 25,000 people, of whom 6,000 are scientists and engineers.

The DRDO functions as a central coordinating agency for the execution of defense-related research (see figure 10-7). For example, it conducts research in the fields of aeronautics, combat vehicles, electronics, naval science, metallurgy, and rockets and missiles. Expenditure on defense R&D as a percent of the total military budget remained relatively constant at approximately 2 percent until the late 1980s, when it jumped to 4.5 percent. This increase was necessary to support the design and development of India's most ambitious defense production programs: the Light Combat Aircraft and Helicopter projects; the Gas Turbine Engine project; and the Arjun main battle tank program.[3] Additional military research is conducted within each defense firm, and by the ordnance factories and universities.

INDIGENOUS AND LICENSED DEFENSE PRODUCTION ACTIVITIES

Naval

In response to India's regional ambitions in the Indian Ocean, the mission of the Indian Navy changed significantly during the late 1970s. According to one analyst:

> The original sea control/shore defense orientation, which largely emphasized preserving the integrity of India's coastal waters against a Pakistani threat, has steadily given way to an assertive naval orientation . . . [The new strategic posture includes] . . . the defense of sea lanes and the preservation of

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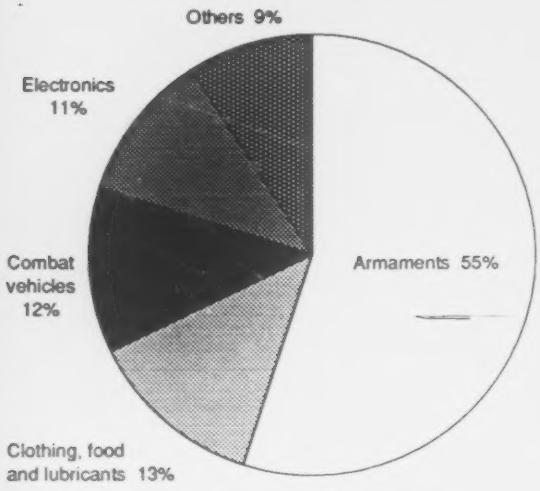
[3] Y. Lakshmi, *Trends in India's Defence Expenditure* (New Delhi: ABC Publishing House, 1988), p. 65

Figure 10-7—Production of the Defense Research and Development Organization



SOURCE: Indian Ministry of Defense, *1989 Annual Report.*

> zones of influence, where the emphasis has shifted from a specifically shoreline defense to a portmanteau conception labelled "defense of the nation's maritime interests."[4]

This includes the defense of India's coastline and seaborne trade as well as its broader economic and foreign policy interests in the Indian Ocean.

To meet these new requirements, India has relied principally on weapon systems purchased from the Soviet Union and Western Europe. The acquisition of the British carrier, *Viraat*, formerly the *HMS Hermes*, has been complemented by an inventory of naval aircraft—Sea Harriers, Tu-142 maritime reconnaissance aircraft, and Dornier 228 light patrol aircraft as well as a number of antisubmarine warfare helicopters including Sea Kings and Ka-27s/25s. Some analysts believe that India is also seeking collaboration with European shipbuilding companies to build a third aircraft carrier.

India's shipbuilding facilities are also engaged in both licensed and indigenous production activities: MDL has produced frigates under British license and is producing Godavari frigates indigenously. The latter 3,000-ton frigate is the only ship of its kind in the world that can carry two helicopters and support antisubmarine warfare. MDL also is building two diesel-powered submarines under license from West Germany's Howaldtswerke Deutsche Werft Ag. (HDW).[5] India's naval fleet has been greatly expanded by recent deliveries of five Soviet Kashin II destroyers, eight Foxtrot and eight Kilo conventional submarines, and one Charlie I nuclear-powered submarine.[6] (A 704-acre submarine dockyard has been built with Soviet assistance at Vishakaputnam, headquarters of the Indian submarine fleet.) Garden Reach Shipyards has manufactured fast patrol craft and inshore patrol vessels for the Coast Guard. Some observers suggest that these new acquisitions will enable the Indian Navy to structure surface strike groups for offensive purposes, while the Navy's submarine force architecture will greatly enhance India's sea control and denial capabilities.[7]

Armor

Although India successfully manufactured the Vijayanta (a modified Chieftain tank) under British license, its indigenous design and production of a main battle tank has been delayed. Initiated in 1980 by the DRDO's Combat Vehicle Development Establishment, the Arjun main battle tank is still in the development phase because of problems related to its power plant. The power plant remains under development at the Gas Turbine Research Establishment. Delays in this program led to the Defense Ministry's decision to license-produce the Soviet T-72 tank as an interim measure.

Missiles

The DRDO, and its Defense R&D Laboratory (DRDL) have made steady progress in India's ballistic missile program. The DRDO has produced and tested the long-range surface-to-air missile Akash, the surface-to-surface missile Prithvi, which has a range of 150 miles and can carry a nuclear payload, the surface-to-air missile Trishul, and the most advanced antitank missile, Nag. However, the apex of the DRDO's missile program has been the development of a new generation of long-range, surface-to-air missiles called Agni. With the Agni's successful May 1989 test flight, India became the first developing nation to design and produce an intermediate-range ballistic missile derived from civilian space activities.[8] The Agni carries a 1-ton payload and is capable of reaching China's southern cities; carrying a half-ton atomic bomb, this missile could hit Beijing (2,200 miles). The Agni program benefited substantially from foreign technical assistance to its sister space program. West Germany provided three indispensable missile technologies: guidance, rocket testing, and composite material handling and fabrication.[9]

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[4] Ashley J. Tellis, "India's Naval Expansion: Reflections on History and Strategy," *Comparative Strategy*, vol. 6, No. 2, 1987, pp. 192-193.

[5] See Dr. Michael Vlahos, "Middle Eastern, North African and South Asian Navies," *U.S. Naval Institute Proceedings*, vol. 3, No. 3, March 1985.

[6] Tellis, op. cit., footnote 4, p. 204.

[7] Ibid.

Aerospace

While Hindustan Aircraft Ltd. (HAL) successfully produced the British Aerospace Gnat fighter and its trainer version, Ajeet, as well as the HS-748 military/commercial transport aircraft, its attempts to design and produce indigenous supersonic combat aircraft have failed. One example was the development of the HF-24 Marut fighter during the late 1950s and 1960s. HAL designed and eventually fabricated the airframe but neglected to develop a suitably advanced engine. By the time an imported engine (a MiG-19 Vk-7) was modified and fitted, the plane was technologically obsolete. India has been forced to abandon its policy of self-reliance in defense production because design or production problems frequently resulted in the cancellation of projects (Ajeet), and because of the lack of engineering and quality control expertise.[10] India increasingly has relied on licensed production and outright procurement of foreign weapons systems. As one Indian defense scientist quipped, "Every time we need to develop a better mousetrap, the country has to import a better cat."[11]

Strong Indo-Soviet military cooperation has developed in the wake of India's failed policy of self-reliance in defense production. India is the only country outside the Warsaw Pact to license-produce Soviet aircraft, and it has gained considerable experience in the manufacture of the MiG-21/-21*bis*, and the MiG-27. HAL will shortly produce MiG-29 Fulcrums.

Beginning in the early 1970s, HAL wanted to diversify and looked to West European aircraft companies to license-produce an advanced fighter and to transfer the technologies related to their materials and components. Of the possibilities—the French Mirage 2000, the Swedish Viggen, and the Anglo-French Jaguar, the latter was chosen in 1978. Though HAL has assembled two-thirds of the 116 fighter aircraft, attempts to indigenize component production have been frustrated. One of the major problems is the preference by the Indian armed forces to purchase weapon systems from abroad.

In an important departure from its role as an assembler of foreign-made aircraft, HAL, with the DRDO, has embarked on an ambitious program to design, develop, and produce a combat aircraft for the Indian Air Force (IAF) requirements of the 1990s. The Light Combat Aircraft (LCA) project is receiving considerable design and technical assistance from U.S. and European companies. General Electric has supplied seven F404 engines to power the LCA prototypes. These engines are eventually to be replaced by the indigenously designed and manufactured GTX-35 gas turbine engine. Various U.S. companies—Allied-Signal, Litton, and Honeywell—are bidding to provide the LCA's flight control and other electronic systems. The U.S. Air Force reportedly will provide training, consulting, and test facilities.[12] Finally, HAL, in partnership with Messerschmitt-Bölkow-Blohm in Germany, is in the development phase of an Advanced Light Helicopter program, which will complement the IAF's squadrons of Chetak (Alouette III), and Cheetah (Lama) helicopters.[13]

U.S. responsiveness to India's requests for technology transfers and supplies of critical components for the LCA project marks a significant departure from the previously strained Indo-American relationship. Some observers believe that if the United

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[8] "Another Long-Range Missile Developed," *India Weekly*, July 17, 1987, p. 10, and Richard M. Weintraub, "India Tests Mid-Range Agni Missile," *The Washington Post*, May 23, 1989, pp. A1, A21.

[9] For a thorough account of West Germany's participation in India's ballistic missile program, see Gary Milhollin, "India's Missiles—With a Little Help From Our Friends," *The Bulletin of Atomic Scientists*, vol. 45, No. 9, November 1989, pp. 31-35.

[10] Interviews with various defense company officials.

[11] "India: Indigenous Programs Flourish Amid Defense Modernization," *International Defense Review*, vol. 19, No. 4, 1986, p. 436.

[12] Ian Anthony, "The Trade in Major Conventional Weapons," in Stockholm International Peace Research Institute, SIPRI Yearbook 1989, *World Armaments and Disarmament* (Oxford: Oxford University Press, 1989), p. 212.

[13] Hiroshi Kimura, "Air Forces in the Asia Pacific Area," *Defence Asia-Pacific*, vol. 2, 1989, p. 25.

States establishes a firm foothold in India's defense production program, it may achieve the twin objectives of extending U.S. influence and providing export opportunities for American defense companies, while reducing India's dependence on the Soviet Union. The Soviet Union has sought to counter this challenge to its strong defense relationship with India by offering to integrate the LCA's characteristics into the yet undeveloped MiG-35 aircraft.

Chapter 11

The Developing Defense Industries of the Western Pacific

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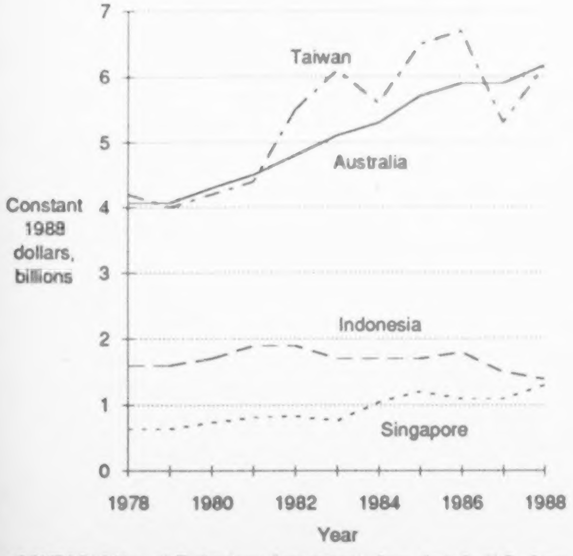
Chapter 11

The Developing Defense Industries of the Western Pacific

The development and expansion of domestic arms production capabilities in the Western Pacific countries reviewed in this chapter—Australia, Singapore, Indonesia, and Taiwan—have necessitated substantial government investment and procurement (see figure 11-1). This figure, however, obscures the disparity in the levels of defense industrialization among these four countries. One of the primary reasons for this disparity is their relative access to advanced arms and high-technology imports. The small size of Australia's domestic defense industry may be explained partly by the ready availability of weapons systems from the United States and Europe. In contrast, Taiwan, Singapore, and Indonesia have more restricted access to foreign arms imports, which has spurred the expansion of their defense production programs.

Each of these states has been equipped by Western countries (see figure 11-2), and there has been substantial equipment standardization among them, partly because the United States has been the principal arms supplier to the region. Australia, Taiwan, Singapore, and Indonesia have all imported Northrop's F5-E fighter aircraft. These same four countries also imported the U.S. AIM-9L air-to-air missile. In addition, C-130 Hercules military transport aircraft have been acquired by Singapore, Indonesia, and Taiwan.

Figure 11-1—Defense Expenditures in Four Western Pacific Nations, 1978-88



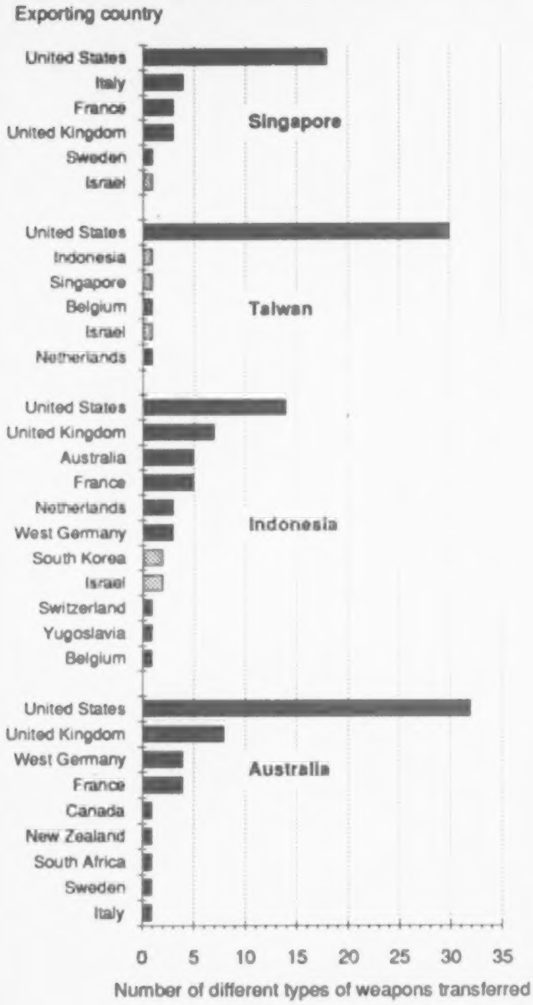
SOURCE: Office of Technology Assessment, from data in U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1989* (Washington, DC: U.S. Government Printing Office, 1990).

The arms production capabilities of these Western Pacific countries also vary in accordance with their respective manufacturing bases, military R&D programs, and government policies. Taiwan's technical expertise and diversified industrial base have enabled it to develop and build an indigenous high-performance combat aircraft in less than 10 years. The lack of a sufficient technological base and financial resources have precluded Singapore and Indonesia from embarking on similar defense projects. Instead, Singapore's and Indonesia's more modest defense production efforts consist largely of component manufacture and assembly work for the aircraft, shipbuilding, and ordnance sectors.

The development of the Western Pacific defense industries, however, has been significantly aided by the involvement of and technology transfers from U.S. and European defense companies through direct investment (Singapore), joint ventures (Australia), and licensed production (all) (see figures 11-3 and 11-4). Licensed production activity by U.S. companies is concentrated in the aircraft sector of these defense industrializing countries, although many countries have licensed other types of weapons for indigenous production in the Western Pacific. Australia, Indonesia, and Taiwan have manufactured various helicopters under U.S. license, including Blackhawk, Seahawk, and Bell utility. Germany dominates in the shipbuilding sectors of Singapore and Indonesia, providing licenses for the production of PB-57 fast attack craft (see figure 11-5).

These countries have also benefited from their location in the lucrative Asia-Pacific market. Singapore's reputation as a regional aerospace center was boosted by its hosting of the 1988 Asian Aerospace Show (which included 674 companies from 31 countries) and by the 1989 Defense Asia exhibition (the first defense exhibition in Southeast

Figure 11-2—Imports of Major Conventional Weapon Systems by Four Western Pacific Nations, by Exporting Nation, 1970-90

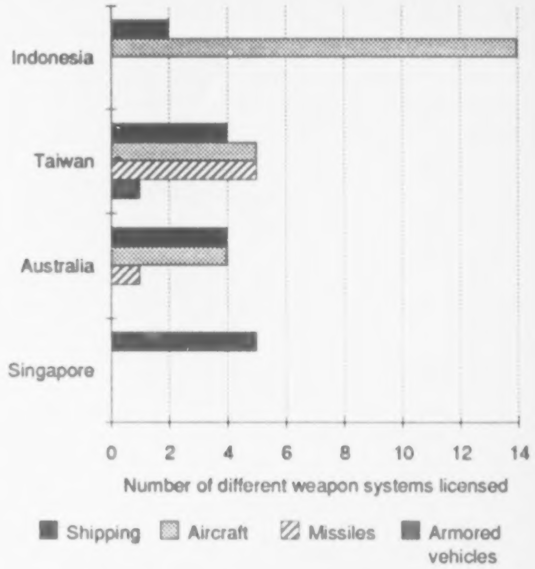


Gray bars indicate developing countries

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Asia to be certified by the U.S. Commerce Department). The continued increase in Asia-Pacific trade is also likely to bolster the region's domestic and foreign-based commercial shipbuilding and aircraft industries.

Figure 11-3—Licensed Production of Major Conventional Weapon Systems in Four Western Pacific Nations, by Type of Weapon, 1970-90

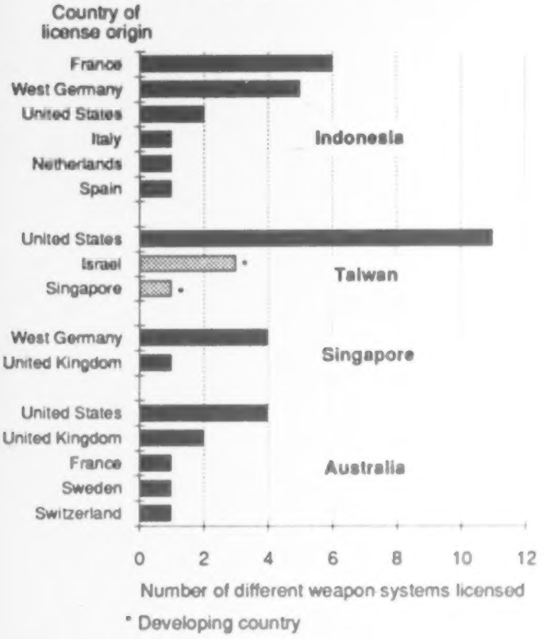


SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

THE DEFENSE INDUSTRY OF SINGAPORE

Although Singapore's development of a defense industry since the 1970s has been linked closely to the country's industrialization program, strategic considerations provided the industry's initial impetus. Singapore is located at the entrance of the Malaccan Straits, which connect the Indian and Pacific Oceans—the so-called Gulf-to-Japan route. As an export-dependent economy, Singapore is vulnerable to interruption of its vital trade channels. The country also has been sensitive to regional developments: the withdrawal of British forces from Southeast Asia in the 1970s, the increased Soviet influence in the region, the Vietnamese invasion of Cambodia, and the Communist insurgencies in Thailand, Malaysia, and the Phillipines. In response to the perceived destabilization of the region during the 1970s, Singapore encouraged military cooperation within the Association of Southeast Asian

Figure 11-4—Licensed Production of Major Conventional Weapon Systems in Four Western Pacific Nations, by Country of License Origin, 1970-90



SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament*.

Nations (ASEAN) and through the Five Power Defense Arrangement.[1]

On a per-capita basis, Singapore is Asia's third wealthiest nation (behind Japan and Brunei). Its gross national product (GNP) growth over the last several years has averaged 11 percent, the largest in ASEAN.[2] The country's economic dynamism is explained by its export-oriented industrialization strategy in alliance with U.S., European, and Japanese transnational corporations, which were attracted to Singapore because of its location and modern infrastructure. Singapore has used this strong manufacturing base to create the most diversified and technologically advanced arms industry in ASEAN.

Singaporean Defense Industrialization

State promotion of defense industrialization has involved various forms of direct and indirect intervention in the Singaporean economy. The most important manufacturing sectors are transportation—aircraft and shipbuilding—and electronics. During the late 1960s, the Singaporean Government carefully promoted the shipbuilding industry, with special focus on construction and repair. The government invested heavily in three shipyards:

1. Singapore Shipbuilding and Engineering Pte. Ltd.,
2. Sembawang Shipyard (which was established as a private limited company with 75 percent government ownership to take over the Royal Naval Dockyard), and
3. Keppel Shipyard Pte. Ltd. (which was separated from the Port of Singapore Authority to form a wholly government-owned enterprise).[3]

Singapore also became increasingly attractive as an export base for Japanese shipping companies.

In addition to these activities, the Singaporean Government directly fostered the active participation of multinational corporations in the country's aircraft industries through financial and tax incentives. For example, companies were exempted from the usual 33-percent corporate income tax for up to 10 years. Companies such as Pratt & Whitney, Hawker Pacific, TRW, General Electric, Sundstrand, Garrett, and Westinghouse made major direct investments in component manufacture, assembly, and repair-service work; they were also attracted by Singapore's skilled low-wage labor. It is estimated that Singapore's wage costs are half those of the United States or Western Europe; this has resulted in production savings of 25 to 40 percent for some aircraft companies.[4]

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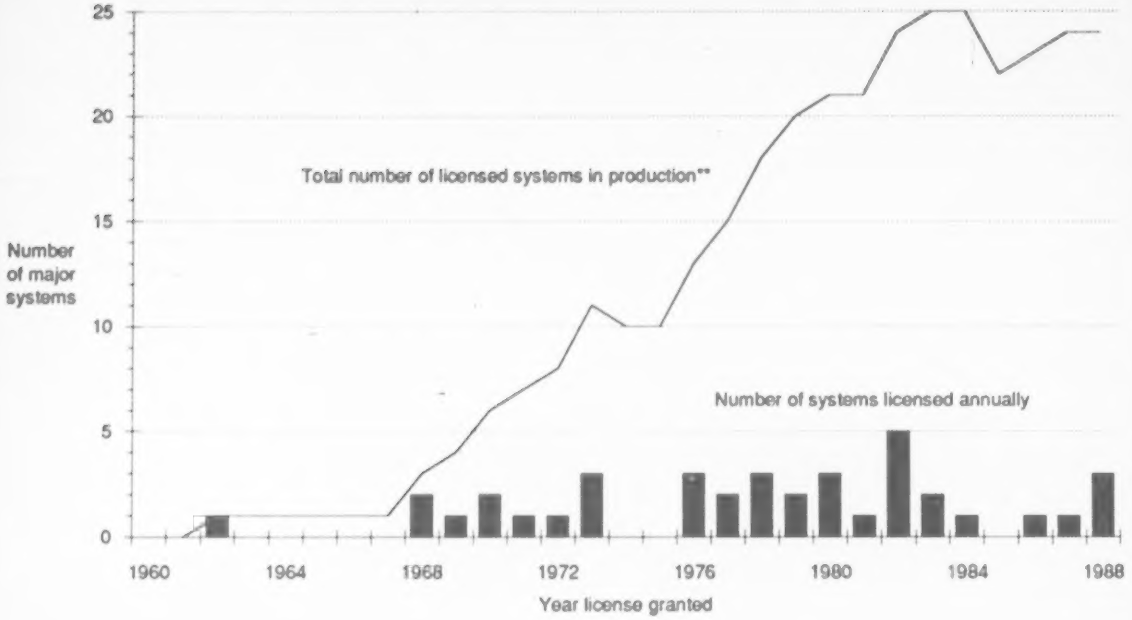
[1] The bilateral security assistance provided by Britain to Malaysia and Singapore was terminated in 1971 and was replaced by a broader regional security agreement called the Five Power Defence Arrangements. This security framework involves Britain, Australia, New Zealand, Malaysia, and Singapore.

[2] *World Bank Development Reports* (Washington, DC: World Bank, various years).

[3] Gary Rodan, *The Political Economy of Singapore's Industrialization: National State and International Capital* (New York, NY: St. Martin's Press, 1989), p. 95.

[4] David Saw, "The Emergence of the Third World Aircraft Industry," *Military Technology*, vol. 4, No. 4, 1988, p. 51.

Figure 11-5—Estimated Licensed Production of Major Conventional Weapon Systems in Four Western Pacific Nations,* 1960-88



*Indonesia, Taiwan, Singapore, and Australia.

**Estimates based on the assumption that an average system is produced under license for 12 years.

SOURCE: Office of Technology Assessment, from data in Stockholm International Peace Research Institute, SIPRI Yearbooks, 1970 through 1990, *World Armaments and Disarmament.*

Foreign investment in the local aerospace industry rose from $28 million in 1977 to $480 million 10 years later.[5] The decision by overseas aerospace companies to locate their regional activities in Singapore has been reflected in the dramatic growth of industrial output in the aerospace sector: from $47 million in 1977 to $795 million in 1987.[6] Many foreign airline companies now use Singapore as a base for the repair, overhaul, and support of aircraft engines and other systems. In particular, investments by Garrett and Vac-Hyd in the aircraft component industry represented impressive gains in technology available in Singapore.[7]

In order to upgrade technologically the economy's defense industrial base as well as sustain higher value-added manufactured exports, the Singaporean Government has also assisted the electronics, fabricated metal, and precision equipment industries. Foreign investment during the 1970s in these sectors was substantial and included the location in Singapore of Hewlett-Packard, National Semiconductor, SCM, Sundstrand Pacific, and Cincinnati Milacron, among others.

After 1979 the Singaporean Government embarked on a massive incentive program for investments in public and private sector R&D. Liberal capital depreciation allowances were provided for plant and machinery and subsidized financing for firms restructuring or upgrading their technological activities. The government also devised a 10-year Master Plan (1980-90) to improve the country's technological infrastructure. For example, the plan provided for the development of Selectar Air Base for the aeronautical industries, and for the construction of the Singapore Science Park to accommodate the country's major industrial and scientific enterprises. While direct government R&D expenditure increased dramatically in the mid-1980s (from 0.4 percent of GNP in fiscal year 1981-82 to 0.6 percent in fiscal year 1984-85), it still lags behind other developing countries in Asia (South Korea 1.4 percent of GNP, Taiwan 1 percent).[8] In 1988 the government launched the International Direct Investment program as a means of broadening Singaporean investment in industries that access new technologies and international markets for higher value-added manufactures and services.

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[5] Ibid.

[6] Ibid.

[7] According to Rodan, Garrett's investment in a casting project enabled the company to supply induction hardened parts to other Garrett plants in Europe and the United States. Vac-Hyd implemented a manufacturing process for the heat treatment of aircraft engine components. Rodan, op. cit., footnote 3, p. 134.

Structure of Singapore's Defense Sector

Singapore's defense industries are primarily owned by the government through a holding company, Shoeng-Li. Founded in 1967 as the Chartered Industries of Singapore, the arms industries were reorganized in 1983 to form the Singapore Technology Corp. (STC). STC was structured to gain R&D production efficiencies through cooperative resource sharing and to market Singaporean military equipment. STC employs a labor force of over 8,000 employees, generates $526 million in annual sales,[9] and is Singapore's largest domestic enterprise. Because of government funding, it is able to purchase the latest technology to develop defense products in which its subsidiaries have the necessary expertise.[10]

Although the Ministry of Defense is responsible for STC's operations, its subsidiaries are run according to commercial guidelines. STC is composed of four groups:

1. Singapore Technologies Industrial (23 companies),
2. Singapore Technologies Aerospace (6 companies),
3. Singapore Technologies Marine (1 company), and
4. Singapore Technologies Ordnance (17 companies).

Of the four divisions, Singapore Technologies Aerospace (STA) is the most prominent. It employees nearly 3,000 people and has 6 subsidiaries. The largest of these is Singapore Aerospace Manufacturing Co. (SAMCO), which is responsible for maintenance and refurbishment of the Singaporean Air Force's inventory as well as those of other air forces in the region. Singapore's defense programs include refitting the A-4S-1 Super Skyhawk fighter-bombers with the more powerful GE F404 engines for the Air Force; refurbishment and replacement of the avionics system of the C-130 Hercules military/civil transport aircraft for the U.S. Navy, and assembly from kits of S-211s and AS-332 Aérospatiale Super Puma helicopters. Two subsidiaries work on engine overhaul for Pratt & Whitney, General Electric, and Grumman. Another subsidiary, Singapore Aero-Components Overhaul, manufactures subcomponents for the General Dynamics' F-16 and Northrop's F5E/F.[11]

STA recently has begun to acquire technology by investing abroad. STA through STC has a 2-percent participation in Pratt & Whitney's PW4000 engine project (more than Japan's Kawasaki Heavy Industries or South Korea's Samsung Aerospace). The engine is already being used to power the A310 Airbus in Singapore Airlines and could also be used in Boeing 747 and 767 aircraft, as well as the MD-11. In January 1988 a joint venture was established between British Aerospace (BAe) and STA/STC for the manufacture, repair, and integration of BAe components in return for marketing services.[12] In addition to the government-owned aerospace sector, there are over 25 companies in Singapore's private sector that manufacture aircraft components and are affiliated with such multinational aviation firms as United Technologies of the United States and Hawker Siddley of the United Kingdom.

STC's second major division is the Singapore Shipbuilding & Engineering Co. (SSE). Its production capabilities have been limited because of the relatively small naval procurement budget and local private competition for ship repair work from the larger Vosper Shipyard. During the mid-1970s SSE built seven TNC-45 fast attack craft (four for Singapore's Navy and three for Thailand's). It is also constructing five Type-62, 500-ton missile corvettes under license from Germany's Luerseen Werft. The naval ship repair business is expected to increase as a result of France's decision to use SSE for repair and overhaul work on its fleets operating in the Indian and Pacific Oceans.

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[8] Ibid., p. 180.

[9] *Armed Forces Journal International*, February 1990, p. 67.

[10] See "The Singapore Technology Corporation: Singapore's Own Military- Industrial Complex," *Pointer*, vol. 11, No. 1, October-December 1984, pp. 12-23.

[11] Bilveer Singh, "ASEAN's Arms Industries: Potentials and Limits," *Comparative Strategy*, vol. 8, No. 2, 1989, pp. 249-264.

[12] "Singapore Shoots for the Sky," *Asiaweek*, Mar. 11, 1988, pp. 50-51.

STC oversees Singapore's ordnance industry. The ordnance sector consists of six subsidiaries, including the former Chartered Industries of Singapore, Ordnance Development and Engineering (which indigenously designed and produces the Ultimax-100 light machine gun), Singapore Automotive Engineering, Singapore Computer System, Singapore Automotive Leasing, and Unicorn International. Together these companies manufacture small-to-medium caliber infantry arms and their ammunition, and provide maintenance and modernization services for the Singaporean Army.

Exports

Singapore's defense exports, including sales of finished weapons systems and subcomponents, are extremely difficult to estimate. As Stockholm International Peace Research Institute (SIPRI) analysts note, there are a variety of trade channels: through Singaporean private defense-related producers; from Singaporean and other countries' companies through Unicorn, STC's export trading firm; and through Chartwell, a Singaporean-Chinese trading company. SIPRI reports that companies which have exported systems through Unicorn include General Dynamics; Rascal & Ferranti (U.K.); and Bofors & Ericsson (Sweden). While Unicorn is the obvious conduit for most of Singapore's defense exports, exports from the other two channels are much harder to decipher. Singapore's aerospace exports by STC subsidiaries were estimated at $116 million in 1988, making the country the largest exporter of aircraft and parts in ASEAN.[13]

THE DEFENSE INDUSTRY OF INDONESIA

Among the ASEAN countries, Indonesia possesses the second most diversified and advanced defense industrial base. Its emergence since the mid-1970s has been conditioned by the country's geostrategic position, in conjunction with a deliberate policy of economic and technological modernization.

Strategic Motivations and Defense Policies

Indonesia's decision to invest in a defense industry reflected the government's aim to reduce dependence on other countries for the purchase and supply of weapons. Accordingly, Indonesia shifted its arms procuement pattern from heavy reliance on Soviet imports (1958-65) to purchases from the United States and West European suppliers (1967-76).[14]

Indonesia is an archipelago of over 13,000 islands situated along the straits leading from the Pacific into the Indian Ocean. Indonesia's articulation of a security doctrine of *wawasan nusantura* is based on its archipelago concept, which posits the indivisibility of land, sea, and airspace within the country's boundaries.[15]

Since its initial formulation in 1957, various factors have strengthened Indonesia's *wawasan nusantura* defense policy. The first was the perceived regional threat posed by the emergence in 1975 of a unified and militarily strong Vietnam. The second was the extension of Indonesia's maritime jurisdictions and its proclamation in 1980 of a 200-mile exclusive economic zone, following the provisions in the Law of the Sea Treaty. (Both Indonesia's Air Force and Navy have been restructured and equipped with Boeing-737 Surveillers and Nomad Search Masters as well as a small frigate force to defend its offshore oil fields and economic zone claims.) Third, Indonesia has been concerned about the continued naval presence of the superpowers and India's expansion of its naval fleet in the Indian Ocean.

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[13] T. Ohlson, "The Asean Countries: Low-Cost Latecomers," M. Brzoska and T. Ohlson, eds., *Arms Production in the Third World* (London: Taylor & Francis, 1986), pp. 57-61.

[14] Ibid, p. 57.

[15] Donald E. Weatherbee, "Indonesia: Its Defense-Industrial Complex," in James Katz, ed., *The Implications of Third World Military Industrialization: Sowing the Serpent's Teeth* (Lexington, MA: Lexington Books, 1986), pp. 165-185.

Together these strategic concerns and the Indonesian Armed Forces defense posture, "Total People's Defense System," have had a significant impact on the reorganization of the armed forces and the country's defense production program. The importance attached to Indonesia's defense sector stemmed from the national leadership's belief in the sector's contribution to both national security and economic development. This inseparability is manifested by the government's emphasis on dual-use defense industries. For example, the impetus for Indonesia's ambitious aerospace industry derives from civil as well as military objectives.[16] This industry is regarded as an integral part of the country's broader industrialization plan. As one Indonesian Minister reasoned:

> Now look at my country: 13,400 islands, from west to east a distance equal to that between San Francisco and New York. . . . We need aeroplanes and helicopters. We have a huge potential market.[17]

Such reasoning underpins the defense industrial rationale for Indonesia's development of its own airframe industry and design capability to produce aircraft for the country's short-to-medium haul transport routes.

Government Promotion Policies

Indonesia's defense sector consists of eight strategic industries, though only four are directly engaged in defense production. These four companies are: PT IPT Nusantara (aerospace), PT PAL Indonesia (shipbuilding), PT Pindad (small arms ammunition), and Perum Dahana (explosives). In addition, the government runs an R&D institute at the Puspitek Centre in Serpong, whose function is to develop and transfer new defense-related technologies to the defense industries. They are all government-owned and are under the control of the Council of Ministers on Strategic Industries.

The overall costs of subsidizing the defense industries are impossible to estimate because they are classified as strategic industries, and are thus closed to external review and audit. Analysts generally assume, however, that such high-technology industries are funded by off-budget means.

In addition to the policy of state-ownership, the Indonesian Government has used a number of infant-industry protectionist measures. It has banned the import of small aircraft and ships, and insists that both private and public transportation operators purchase state-produced equipment. Indonesia's domestic airline, Bouraq, has been forced to replace its fleet of Fokker F-50 passenger aircraft with locally built CN-235s designed primarily for cargo transport.[18]

In order to expand Indonesia's defense production base, the government has encouraged extensive involvement by foreign corporations in the country's defense industries. This involvement has occurred through transfers of technology, know-how, licensing, offsets, and joint ventures. As a result, Indonesia, like its ASEAN neighbors, is highly dependent on imported designs, components, and technical assistance. As figure 11-4 above indicates, Indonesia's sources of licensed production are the most diversified of the Western Pacific countries. Its aircraft industry has manufactured helicopters under license from U.S., German, and French defense firms. In aircraft, Indonesia has relied on U.S., Spanish, French, and Italian technology transfers. Indonesia's arms industry has benefited considerably from such technology transfers, enabling the sector to increase its technological sophistication while bypassing many of the usual developmental stages.

A corollary to a liberal technology transfer policy is the government's attempt to generate spillovers from defense into civilian industries, reinforcing the acquisition of dual-use technologies. The Indonesian Government has provided domestic and multinational automotive and electronics industries with fiscal and export incentives to encourage the development of related technologies and subcomponents.

Finally, Indonesia's impressive progress in defense-related production has been attributed to the efforts of Dr. B.J. Habibie, Minister for Research and Development, and director of the Agency for Development and Application of Technology (BPPT). Habibie, a former technical director of the German aerospace giant, Messerschmitt-Bölkow-Blohm (MBB), and an Indonesian national, presides over

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[16] Singh, op. cit., footnote 11, pp. 243-264.

[17] "Indonesia's Dynamic Aircraft Industry," *Southeast Asia Development Digest*, June-July 1988, p. 20.

[18] *Armed Forces Journal International*, op. cit., footnote 9, p. 62.

Indonesia's defense-industrial sector, and is credited with the development in Indonesia of one of the world's best equipped airframe manufacturing facilities.

Indonesia's Defense Companies

The centerpiece of the Indonesian defense industry is the state-owned firm, PT IPT Nusantura. Established in 1976 from the Air Force's Institute for Aviation Industry in Bandung as well as from Pertamina's Advanced Technology and Aeronautics Division, the company now employs 12,750 people whose average age is only 24 years old.[19] Nursantura reportedly has produced over 92 commuter aircraft and 125 helicopters. The company, in keeping with Indonesia's heavy reliance on technology transfers, has licensed-production agreements with France's Aérospatiale for Super Puma antisubmarine warfare helicopters, Germany's MBB for BO-105 utility helicopters, Textron in the United States for 412 transport liaison helicopters, and with Spain's Construciones Aeronauticas S.A. (CASA) for the CN-212 and CN-235 medium transports. Its most ambitious project is the indigenously designed Advanced Air Transport Plane, the ATRA 90. This propfan, 50-passenger aircraft is being jointly developed with Boeing.[20]

In July 1989, British Aerospace reached an agreement to increase industrial subcontracts as a result of Indonesia's acquisition of various BAe products, including the Hawk and the Rapier surface-to-air missile. Other offset arrangements, which reflect IPTN's emergence as a competitive overhauler and aircraft parts manufacturer, include component production for Fokker-100 and F-16 aircraft. (The 1986 F-16 offset agreement with General Dynamics ensured Indonesia's military parity with its ASEAN rival, Singapore.)[21]

The success of the Indonesian aircraft industry is evidenced by the fact that in 1976 only 10 percent of the component parts for aircraft were manufactured locally. Today 90 percent are produced either at the Bandung factory or by other Indonesian subcontractors. The Indonesian aircraft industry has also found a small, but useful export market in various developing countries: Thailand purchased five CN-212s, Saudi Arabia bought four CN-235s, Brunei has also ordered several CN-235s, and Malaysia has purchased one Super Puma.

PT PAL, the naval shipbuilding firm, is Indonesia's second major defense concern. Although PT PAL has built fast patrol boats and search and rescue vessels using designs from the Maritime Engineering School, limitations within the shipbuilding sector have encouraged further foreign collaboration and purchases. The yard produces under license Boeing hydrofoils (which are fitted with missile capabilities) and Luerssen/Fulton Marine missile fast attack craft. Despite these achievements, Indonesia's Navy is reaching "block obsolescence." In an effort to sustain a limited modernization program, Indonesia has purchased four former Dutch Navy Van Speijk-class frigates. Still, Indonesia's aging fleet will require considerable investment by the government if it is to remain committed to modernizing the PT PAL Surabaya shipyard for naval shipbuilding.[22]

The production of small arms and ammunition is based at the government-owned main factory PT Pindad. Pindad manufactures semi-automatic rifles under license from Pietro Beretta of Italy; M-16s and 5.56 assault rifles under license from Colt Industries in the United States; and FNC rifles under license from Fabrique Nationale Herstal in Belgium. Indonesia at present does not produce any guided missiles. A factory at Perum Dhana, however, does manufacture explosives and rockets.[23]

THE DEFENSE INDUSTRY OF TAIWAN

The Carter Administration's "derecognition" of the Republic of China on Taiwan (ROC) in 1979, because of the overarching U.S. policy objective of pursuing normalization of relations with the People's Republic of China (PRC), drastically altered Taiwan's strategic as well as international positions. The United States had been the mainstay of the security of Taiwan since 1954. Taiwan depended heavily on U.S. security assistance, especially arms transfers. Most of these transfers were for aircraft, combat equipment, and missiles. Divested of formal security assistance with the termination of the Mutual Defense Treaty, and with a subsequent 1-year moratorium on U.S.-Taiwanese arms transfers, Taiwan's security was increasingly threatened. By 1982 the PRC had augmented its military capabilities, reaching a 10:1 superiority over Taiwan in armed forces and conventional weapons. In terms of the naval balance, for example, the International Institute of Strategic Studies estimates that the PRC is superior to Taiwan in frigates, 37 to 10; in patrol and coastal craft, 915 to 73; and in submarines, 93 to 4.[24]

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[19] "Indonesia's Dynamic Aircraft Industry," op. cit., footnote 17, p. 2[illegible].

[20] Ohlson, op. cit., footnote 13, p. 59.

[21] *Armed Forces Journal International*, op. cit., footnote 9, p. 62.

[22] Ibid., p. 63.

[23] Singh, op. cit., footnote 11, p. 63.

Under pressure from congressional supporters of the Taiwan Relations Act, the Reagan Administration recommenced transfer of military equipment, including air-to-ground missiles and armored vehicles. It also allowed for the extended licensed production of 60 Northrop F-5E aircraft. The administration decided, however, not to accede to Taiwan's request for the acquisition of an advanced tactical fighter such as the F-16, the F-20, or F/A-18, nor the coveted Harpoon antiship missile.

In addition to these strategic concerns, Taiwan's international isolation increased in the early 1980s, as other nations feared strained relations with the PRC should they continue or initiate arms sales to the island. The ROC was also excluded from various international organizations, including the United Nations. Though Taiwan still retains security ties with Israel, Saudi Arabia, South Africa, and South Korea, there are limits to the exports by these countries of technologically advanced weapons systems.

In response to these developments, the Taipei government embarked on an ambitious program of "self-reliant national defense." As one analyst observed:

> This was made possible by the provision by the United States on a selective basis of technological inputs and expertise to initiate and advance indigenous production programs . . . . As such, American policy provided both the incentives and the means for Taiwan to develop a defense industrial capacity.[25]

Taiwan has relied extensively on licensed production of U.S. weapon systems to supplement the parallel decline in U.S. grant assistance and to buttress its own indigenous defense production efforts (see figure 11-4, above). Throughout the 1970s and 1980s, Taiwan has assembled the F-5E Tiger II fighter, the Bell 205 UH helicopter, and various missiles, including the air-to-air AIM-9J/9L and the Hawk MIM-23 surface-to-surface missile, all under U.S. licenses. Taiwan has also received assistance from Israel to develop its missile and shipbuilding industries. It license-produces the Israeli Gabriel ship-to-ship missile and the Dvora fast attack craft.

Unlike other East Asian newly industrializing countries, Taiwan's indigenous defense production program is driven less by export incentives than by the strategic threat posed by a PRC naval blockade of Taiwan's principal ports (especially Kaohsiung, which handles approximately 65 percent of the island's trade). To deter such an attack by the PRC's submarine fleet, the Taipei government has invested heavily in the naval sector (antisubmarine warfare capabilities and surface attack boats, equipped with antiship missiles). Additionally, to maintain the ROC's tactical air superiority over the Taiwan Straits, the Indigenous Defense Fighter (IDF), a supersonic, lightweight fighter, was developed indigenously and deployed in December 1989.[26]

Taiwan's Defense Companies

Established in 1969 in Taichung, the Aero Industry Development Center (AIDC) is a branch of the Taiwanese Air Force and currently employs more than 3,000 workers.[27] Similar to the experiences of other aircraft producers in the region, the AIDC's recent production of its first defense fighter, the IDF or Ching Kuo, is based on a phased development program. The AIDC's capabilities grew from maintenance and overhaul work to the licensed production of various aircraft, principally the Bell UH-1H helicopter for the Army and the F-5E/F fighter for the Air Force.[28]

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[24] International Institute of Strategic Studies, *The Military Balance, 1990-1991* (London: Brassey's, 1990), pp. 149-150, 178. For a thorough overview of U.S.-Taiwan security relations, see Stephen P. Gilbert, "Safeguarding Taiwan's Security," *Comparative Strategy*, vol. 8, No. 4, 1989, p. 439.

[25] Janne E. Nolan, *Military Industry in Taiwan and South Korea* (London: Macmillan Press, 1986), p. 47.

[26] For a good analysis linking Taiwan's defense policy objectives to the country's arms production program, see A. James Gregor, "The Republic of China on Taiwan," in Katz, op. cit., footnote 15.

[27] Saw, op. cit., footnote 4, p. 49.

The IDF aircraft, which analysts claim to be comparable to the Northrop F-20, will replace Taiwan's obsolete front-line interceptors, Lockheed F-104s and Northrop F-5E/Fs. The production costs of this program are estimated at over $1 billion, but financing has not been a constraint. The fighter's short delivery time would not have been possible without substantial assistance from U.S. defense companies, which supplied technical expertise and components. General Dynamics, in consultation with the government-owned Chungshan Institute of Science and Technology (CIST), helped to design the airframe (which closely parallels the U.S. F/A-18 Hornet). In addition, nearly 100 Taiwanese engineers received training and technical assistance at General Dynamic's Texas facility.[29] Other U.S. companies that have supplied components for the IDF program include Lear Astronautics Corp, which provided avionics integration and the fly-by-wire flight control system; Garrett, which aided the development of the IDF's engine (a modified version of the Garrett TFE-1088 turbofan); and General Electric, which provided the IDF's "look down-shoot down" capability with its GD-53 Doppler fire-control radar, a derivative of the AN/APY-67(V) radar.[30]

Concurrently, AIDC has invested heavily in the indigenous production of components and engines. AIDC manufactures the Lycoming T-53 engines for its Bell helicopters under U.S. license. Taiwan's aircraft industry produces about 40 percent of its required components in conjunction with local private industry. Most of its avionics equipment, however, continues to be imported from the United States.

Taiwan's naval production facility is the state-owned China Shipbuilding Corp. (CSC) in Kaohsiung. In addition to this large shipyard, Taiwan possesses extensive civilian shipbuilding capabilities. Prior to the recession in world shipping demand, these shipyards had been engaged in the extensive construction of oil tankers and large ships for export. The development of Taiwan's indigenous naval capabilities has been constrained by the Navy's preferred reliance on imports of surplus or aging U.S. warships.

The CSC shipyards have refurbished nearly 30 U.S. destroyers and frigates, retrofitting them with modern antisubmarine warfare electronics, fire-control systems, and Sea Chaparrel air defense missiles. CSC also has manufactured the PSMM-MK5 fast attack craft under a U.S. license arrangement with Tacoma Boat Building Co. Owing to complications arising from subsequent U.S. restrictions on the required missiles, the shipyard has switched to producing fast attack craft based on the Israeli Dvora design. Finally, Taiwan's CSC is preparing to construct larger warships, ten 2,000-ton Ulsan-class frigates in cooperation with South Korea's Hyundai Shipbuilding Corp., and 8 FFG-7 Perry-class frigates with the assistance of the U.S. Bath Iron Works Shipbuilders.[31]

Taipei has long considered modernization of its missiles and access to related electronics technologies of vital importance to the island's defense. As a result, Taiwan has sought to improve its air defense system and upgrade its current inventory of U.S. AIM-9 Sidewinder, Hawk, Maverick, and Nike Hercules systems (among others). The country's modest missile production program is based at CIST. This R&D center has developed the Hsuing Feng, a licensed-produced version of Israel's Gabriel 2 antiship missile, and the Ching Feng, a medium-range, surface-to-surface missile. Although CIST claims to have produced this latter missile indigenously, analysts concur that the Ching Feng was probably reverse engineered from the Lance, a U.S. missile currently in Israel's inventory. CIST also is producing a shorter range missile, the Kun Wu, an antitank, wire-guided missile (a variant of the Soviet AT-3 Sagger).[32]

Equipment for Taiwan's ground forces is produced under the Defense Ministry's Combined

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[28] For a thorough analysis of Taiwan's IDF program, see "Fighter Made in Taiwan," *Defense Asia-Pacific*, vol. 2, 1989, pp. 4-7.

[29] Gilbert, op. cit., footnote 24, p. 436.

[30] "Fighter Made in Taiwan," op. cit., footnote 29, p. 7.

[31] "Taiwan To Start Building Warships," *Defense Asia-Pacific*, vols. 3/4, 1989, p. 10.

[32] *Jane's Defense Weekly*, Nov. 17, 1984, p. 890; and Shim Jae Hoon, "Chinese Missile Sales Shake Taiwan's Diplomatic Ties," *Far Eastern Economic Review*, June 2, 1988.

Service Forces (CSF). CSF has three departments related to arms production:

1. the Military Industrial Service, manufacturer of ordnance and related electronics and communications equipment;
2. the Military Vehicles Production Service (also known as the Fighting Vehicles Development Center), producer of armored vehicles; and
3. the Quartermaster Service, manufacturer of uniforms, gas masks, parachutes, and other materiel.

The Military Vehicles Production Service is the largest and most important of these departments. It has designed and produced various armored vehicles, including an armored infantry fighting vehicle based on the U.S. M-118 armored personnel carrier, and a light, Type 64 tank derived from the U.S. M-41. Currently, this department is developing a medium-weight main battle tank.[33]

Government Promotion of Defense-Industrial Linkages

The Taipei Government has actively promoted export-oriented industrialization in conjunction with defense production activities through the development of indigenous R&D as well as through foreign transfers of technology. Since the late 1960s, Taiwan's decentralized science and technology policy has focused on institution building. The National Science Council (NSC), created in 1967, has been responsible for overall guidance, coordination, and evaluation of R&D activities (including higher education) in the public and private sectors. Between 1977 and 1987, NSC financed between 50 and 65 percent of the country's total spending on R&D.[34] Such financing has been considered necessary due to the lack of R&D investment by Taiwan's small to medium-sized manufacturing firms. Out of the approximately 2 percent of GDP spent on R&D, primary emphasis is given to engineering fields, accounting for 70 percent of total R&D expenditure during the 1977 to 1987 period.[35]

In 1973 the Industrial Technology Research Institute (ITRI) was established to promote public and private R&D for defense-related applications. Today ITRI is Taiwan's leading R&D institution and has played a critical role in the development of the country's high-technology defense-related industries. It both introduces its own R&D products to industry and facilitates transfers of technology through its extensive network with universities, research centers, and domestic as well as multinational firms.

In an effort to boost private sector involvement in such critical industries as semiconductors, electronics, precision machinery, and metallurgy, the government established the Hsinchu Industrial Park in 1980. Modeled after California's Silicon Valley, the government solicited high-technology firms by providing tax and duty exemptions, and subsidized facilities such as factory buildings, transportation, and communications networks. The Park's location near Taiwan's premier universities is also meant to attract high-tech firms. By 1989 over 98 firms employing 17,000 people had located in the Park. Total production in 1988 was valued at $1.7 billion.[36]

The outlook for Taiwan's continued pursuit of indigenous development of sophisticated weapons systems is circumspect. For the foreseeable future, Taiwan's arms industries will remain dependent on foreign suppliers of advanced subsystems (avionics and engines) and manufacturing technology. Additionally, despite efforts by ITRI, the linkage of applied, private sector R&D to defense-related activities is still embryonic. Further efforts have been frustrated because of the country's "talent gap"—the brain drain to the United States of Taiwan's highly skilled scientific and technical personnel. Finally, although exports of military equipment to regional neighbors could help recuperate the heavy investments in defense production, access to such markets is likely to be constrained by the countervailing pressures imposed by the PRC. Nevertheless, Taiwan's strong export performance, especially of mid-tech electronics, will be employed by Taipei as an economic bridge to expand and strengthen its foreign relations.

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[33] A.J. Gregor, R.E. Harkavy, and S.G. Neuman, "Taiwan: Dependent Self-Reliance," in Brzoska and Ohlson, op. cit., footnote 13, pp. 239, 243.

[34] See Walter Arnold, "Science & Technology Development in Taiwan and South Korea," *Asian Survey*, vol. 28, No. 4, April 1988, pp. 437-450.

[35] Paul K.C. Liu, Ying-Chuan Liu, and Hui-Lin Wu, "New Technologies, Industry, and Trade — The Taiwan Experience," *Industry of Free China*, vol. 72, No. 4, October 1989, pp. 23-35, and *Industry of Free China*, vol. 72, No. 5, November 1989, pp. 7-24.

[36] Bob Johnstone, "Taiwan's Hi-Tech Hothouse," *Far Eastern Economic Review*, Aug. 31, 1989, p. 47, and "Hi-Tech Dilemma," *Far Eastern Economic Review*, May 15, 1986.

THE DEFENSE INDUSTRY OF AUSTRALIA

The 1969 Guam Doctrine and subsequent U.S. foreign policies towards the Asia-Pacific region led Australia in the 1980s to reconsider its forward defense posture in favor of a strategy that emphasized increased autonomy and self-reliance. Consequently, to reduce the country's heavy dependence on imports of U.S. defense equipment, the Australian government has attempted to expand its small defense industrial base (primarily through increased domestic weapons procurement) and to promote overseas exports of local defense products. Additionally, the Australian Armed Forces were reorganized during the mid-1980s to meet the priorities of first, defending the country, and second, securing Australia's sphere of influence in the Southeast Asian-Pacific region.

As various analysts have pointed out, defense planning is exceedingly difficult because, in conjunction with the country's continent size and vast coastlines, Australia faces no clear, direct military threat.[37] Instead, Australia's strategic concerns are largely regional, deriving from instabilities caused by the Soviet military buildup of the 1970s and by its northern neighbor, Indonesia. Australia's relations with Indonesia have often been strained because of the latter's 1963 to 1966 confrontation with Malaysia, and more recently, Timor. Though an Indonesian threat to Australia is not considered serious, India's rapid expansion of its carrier-based naval fleet is of some concern to Australia's Royal Navy.

Australia also plays a strong regional role in the South Pacific, where smaller nations with more limited economic and defense resources have looked to Australia as the region's policeman. The largest recipient of Australian military assistance is Papua New Guinea, whose territory has been invaded by Indonesian "hot pursuit" raids (see figure 11-6).

In view of potential regional destabilization, Australia has strengthened its defense cooperation program with ASEAN states, especially Singapore and Malaysia. This regional security role has been reinforced under the Australia-New Zealand-United States (ANZUS) defense treaty, as well as through the Five Power Defense Arrangement (Australia, New Zealand, United Kingdom, Singapore, and Malaysia). Under these security arrangements Australia has provided training and advisory assistance as well as joint military exercises and exchange visits of military personnel. The Royal Australian Air Force (RAAF) has deployed two Mirage fighter squadrons in Malaysia and has provided P-3C surveillance aircraft to Singapore and Malaysia.[38]

Defense Production in Australia

Australia's unique strategic position and consequently small military procurement budget have deterred the development of an extensive defense industrial base. In addition, with respect to the acquisition of military equipment generally, there has been a strong predilection by the military towards overseas imports, especially from the United States. In the public sector, the dockyards, eight munitions factories, and one aircraft company continue to perform the same defense work as during World War II, namely, overhaul and refurbishment of aircraft and naval vessels and the production of communications and ground force equipment.[39] However, most of Australia's defense production activity is located in the private sector, which primarily consists of aircraft-related industries.

Aircraft

The Australian Aircraft Consortium consists of the Government Aircraft Factories, Commonwealth Aircraft Corp., and Hawker de Havilland. This consortium is developing a new Australian basic trainer for the RAAF and for export. The Government Aircraft Factories manufactures the indigenous Jindivik remotely piloted vehicle and the Nomad light transport aircraft.

Hawker de Havilland is the licensed producer of the Swiss PC-9 trainer. Under U.S. license this company also assembles Blackhawk and Seahawk

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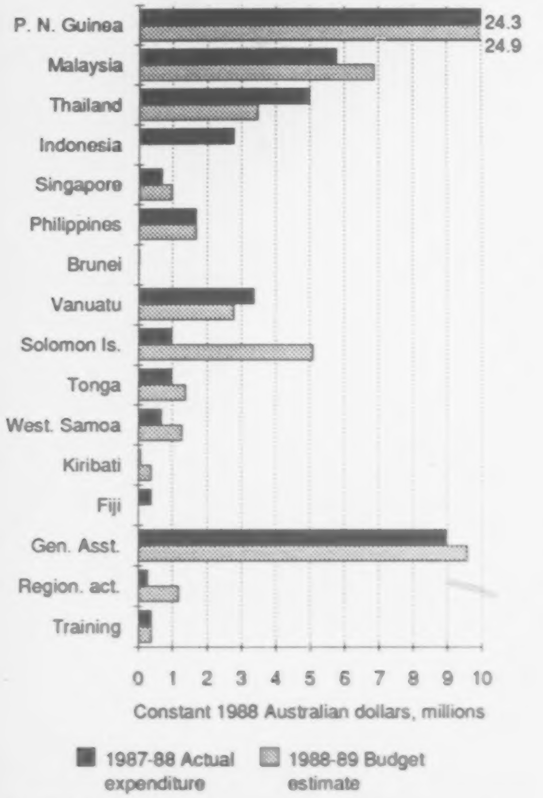
[37] See Robert O'Neill, "Strategic Concepts and Force Structure," in R. O'Neill and D. Horner (eds.), *Australian Defense Policy for the 1980s* (St. Lucia: University of Queensland Press, 1982).

[38] P.D. Hastings, "Australian Regional Defence Cooperation in the 1980s," in ibid., and Australian Senate Standing Committee on Foreign Affairs and Defense, *Australia's Defense Co-operation With Its Neighbors in the Asian-Pacific Region* (Canberra: Australian Government Publishing Service, 1984).

[39] P. Dibb, *Review of Australia's Defense Capabilities*, Parliamentary Paper No. 163 (Canberra: Australian Government Publishing Service, 1986), pp. 110-111.

Figure 11-6—Recipients of Australian Defense Cooperation Funds, 1988-89



SOURCE: Office of Technology Assessment, from data in Graeme Cheeseman, "Australian Defence Exports," *The Pacific Review*, vol. 2, No. 3, 1989.

helicopters and manufactures the airframe and landing gear for the U.S. F/A-18 Hornet. The company provides civil aircraft subassemblies for the Boeing 737, 747, and 757, the MD80, and the Airbus A300 and A320, and manufactures parts and assemblies for the U.S. F404 jet engine. With annual sales of approximately $100 million, de Havilland's production is divided 60 percent for the domestic market and 40 percent for export.

Naval

Carrington Slipways Pty. Ltd. is a shipbuilding company that produces tugs, oil-rig supply vessels and an amphibious heavy-lift ship for the Royal Australian Navy (RAN). De Havilland Marine manufactures the Carpentaria- and Capricornia-class patrol boats. Managed by the Office of Defense Production, Garden Island Dockyard is involved in the repair and refit of the RAN guided missile destroyer modernization program. Vickers Cockatoo Dockyard Pty. Ltd. performs naval overhaul work, including submarines, and construction of warships and heavy naval vessels for the RAN.

Small Arms and Ordnance

The Australian Government's Office of Defense Production includes the Government Aircraft Industries and the nine ordnance factories. The latter produce under license munitions, naval artillery, and small arms (the LIAI assault rifle and the F-1, a locally designed 9 mm submachine gun). Amalgamated Wireless Ltd. is the manufacturer of the Jindalee over-the-horizon-backscatter radar. The battlefield optical fiber cable short-haul communications system, and the HF jammer system for the Australian Army. Amalgamated is also participating in the project definition study for the RAN's new submarine program.

The potential development and expansion of these defense industries is frustrated by the lack of effective guidance from the Ministry of Defense. For example, during a 1974 Industries Assistance Commission's inquiry into the Australian aerospace sector, Australian aircraft manufacturers complained that "the lack of any real policy guidelines . . . from the Government" regarding defense procurement inhibited any corporate strategic planning for meeting the armed forces' defense requirements. Ten years later, a review of the government's own

Photo credit: U.S. Department of Defense

The Royal Australian Air Force procured 75 F/A-18 Hornet fighters, which were licensed-produced in Australia by companies operating under the Australian Aircraft Consortium. Production began in the early 1980s, and the last Hornet fighter was delivered in May 1990.

defense industries acknowledged that "despite significant past expenditure the capabilities and capacities of the Government's defense factories and dockyards are ill-matched to our strategic needs."[40]

To redress Australia's inadequate defense industrial base in the face of its policy of self-reliance, in the mid-1980s the government initiated a four-pronged strategy:

1. rationalization of public-sector defense industries;
2. expansion of defense-related R&D activity;
3. facilitation of greater private-sector involvement in defense production, particularly in the local aircraft, electronics, and shipbuilding industries; and
4. promotion of Australia's defense exports.

Of the four, R&D investment and exports have been accorded the highest priority.

Although Australia's main R&D organization, the Defense Science and Technology Organization (DSTO), has designed a few sophisticated weapon systems such as the Jindalee radar, its capabilities are limited. In fact, observers have commented that DSTO in effect represents a liability because of its limited interaction and cooperation with those organizations engaged in defense-related R&D (academic institutions, other government R&D organizations, such as the Atomic Energy Commission, and high-technology firms). In large part this weak link between government R&D and the defense industry results from inadequate government funding: defense R&D is approximately 3 percent of total defense outlays.

Since 1985 the Australian Government, in conjunction with the Ministry of Defense, has instituted a policy aimed at increasing overseas sales of defense products and services. The objective was to establish Australia as a regional "center of defence excellence," given its already favorable position within ASEAN and the South Pacific. According to one Australian defense industry analyst, such measures include the following:

1. technical and R&D assistance from related government departments, including use of government laboratories and test facilities;
2. marketing assistance through the Australian Trade Commission and in concert with defense personnel (embassy staff, endorsements provided by the armed forces, etc.);
3. provision of spares held in the ADF's inventory to secure arms export agreements and speed delivery times;
4. offset credits for potential buyers of Australian defense products; and
5. joint ventures between Australian and overseas firms as a means of increasing export competitiveness.[41] (Hawker de Haviliand's involvement in the McDonnell Douglas MDX helicopter project is a recent example.)[42]

These measures were not only directed at securing a market niche for Australian firms in the international arms trade, but were also implemented to offset endemic balance-of-payments problems stemming from imports of foreign military hardware. (Approximately 23 percent of the total defense budget—in 1986-87 A$1.72 billion—is spent on imports of defense equipment and related technology transfers.)[43]

To date, Australian defense exports have been relatively modest. They vary from A$100 million to A$500 million per year and consist primarily of small arms and ammunition.[44] The largest importers of Australian equipment are from the industrialized countries (the United States and the United Kingdom). Still, Australia's regional neighbors through the Defense Cooperation Program have been important purchasers as well. Indonesia has purchased Sabre aircraft, patrol boats, and Sioux helicopters. Papua New Guinea has imported Nomad surveillance aircraft, and Malaysia and the Solomon Islands have bought 16-meter patrol boats. However, the combined effects of overcapacity of production in world arms markets and Australia's relatively small and unsophisticated defense sector suggest that Australia's export potential will remain extremely limited.

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[40] Cited in Desmond Ball, "National Security Policy," in O'Neill and Horner, op. cit., footnote 37, p. 147. See also Dibb, op. cit., footnote 39.

[41] See Graeme Cheeseman, "Australian Defence Exports," *The Pacific Review*, vol. 2, No. 3, 1989, pp. 221-222.

[42] P. Lewis Young, "Australia Abandoning Mind-Set of Fighting Other Guy's War," *Armed Forces Journal International*, November 1989, p. 46.

[43] Cheeseman, op. cit., footnote 41, p. 221.

[44] Ibid., p. 220.

Appendix

Appendix A

List of Acronymns

A-12 — Advanced Tactical Aircraft
ABRI — Indonesian Armed Forces
ACDA — Arms Control and Disarmament Agency
ADD — Agency for Defense Development (South Korea)
ADF — Australian Defence Forces
AECA — Arms Export Control Act
AFV — Armored Fighting Vehicle
AIDC — Aero Industry Development Center (Taiwan)
ANZUS — Australia-New Zealand-United States Defense Treaty
APC — Armored Personnel Carrier
ASEAN — Association of Southeast Asian Nations
ASW — Anti-Submarine Warfare
ATBM — Advanced Tactical Ballistic Missile
ATF — Advanced Tactical Fighter
AWACS — Airborne Warning and Command System
BAe — British Aerospace
BEL — Bharat Electronics Ltd. (India)
BEML — Bharat Earth Movers Ltd. (India)
BPPT — Agency for Development and Application of Technology (Indonesia)
BRITE — Basic Research into Industry Technology for Europe
CASA — Construciones Aeronauticas SA (Spain)
CATT — Conventional Arms Transfer Talks
CCMS — Committee for the Challenges of Modern Society (NATO)
CFE — Conventional Forces in Europe
CIST — Chungshan Institute of Science and Technology (Taiwan)
CNAD — Conference of National Armaments Directors (NATO)
CoCom — Coordinating Committee on Multilateral Export Controls
CP$_{q}$M — Naval Research Center (Brazil)
CSC — China Shipbuilding Corp. (Taiwan)
CSCE — Conference on Security and Cooperation in Europe
CSF — Combined Service Forces (Taiwan)
CTA — Aerospace Technical Center (Brazil)
CTE$_{x}$ — Army Technical Center (Brazil)
DASA — Deutsche Aerospace
DCS — Direct Commercial Sales
DoD — Department of Defense
DPACT — Defense Policy Advisory Committee on Trade
DRDL — Defense Research and Development Laboratory (India)
DRDO — Defense Research and Development Organization (India)
DSAA — Defense Security Assistance Agency
DSTO — Defense Science and Technology Organization (Australia)
DTSA — Defense Technology Security Administration
EAA — Export Administration Act
EC — European Community
EFA — European Fighter Aircraft
EIA — Electronics Industry Association
ESPRIT — European Strategic Program of Research in Information Technology
EUCLID — European Long-term Initiative for Defense
EUREKA — European Research Coordinating Agency
EW — Electronic Warfare
EX-IM — Export-Import Bank
FAMA — Fubria Argentina de Materiales Aerospaciales
FHI — Fuji Heavy Industries
FMS — Foreign Military Sales
FSX — Fighter Support/Experimental
GaAs — Gallium Arsenide
GAO — General Accounting Office
GATT — General Agreement on Tariffs and Trade
GD — General Dynamics
GDP — Gross Domestic Product
GNP — Gross National Product
HAL — Hindustan Aircraft Ltd. (India)
HDW — Howaldtswerke Deutsche Werft Ag.
IAE — Institute for Space Activity (Brazil)
IAF — Indian Air Force
IAI — Israel Aircraft Industries
IDF — Indigenous Defense Fighter (Taiwan)
IDF — Israeli Defense Forces
IEPG — Independent European Program Group
IHI — Ishikawajima-Harima Heavy Industries
IMI — Israel Military Industries
INPE — National Space Research Institute (Brazil)
IPTN — IPT Nusantura (Indonesia)
IR&D — Independent Research and Development
ITAR — International Traffic in Arms Regulations
ITRI — Industrial Technology Research Institute (Taiwan)
JDA — Japan Defense Agency
JDF — Japan Defense Forces
JESSI — Joint European Submicron Silicon Initiative
JMTC — Joint Military Technology Commission

KFP	— Korean Fighter Plane
KHI	— Kawaski Heavy Industries
LCA	— Light Combat Aircraft (India)
MASHA	— Renovation and Maintenance Centers—Israel Defense Forces
MBB	— Messerschmitt-Bölkow-Blohm
MBT	— Main Battle Tank
MDAA	— Mutual Defense Assistance Agreement
MDL	— Magazon Docks Ltd. (India)
MDNL	— Mishra Dhata Nigam Ltd. (India)
MELCO	— Mitsubishi Electric Co.
MHI	— Mitsubishi Heavy Industries
MITI	— Ministry of International Trade and Industry (Japan)
MLRS	— Multiple Launch Rocket System
MOA	— Memoranda of Agreement
MOD	— Ministry of Defense
MOFA	— Ministry of Foreign Affairs (Japan)
MOU	— Memoranda of Understanding
MTCR	— Missile Technology Control Regime
NATO	— North Atlantic Treaty Organization
NSC	— National Science Council (Taiwan)
OECD	— Organization for Economic Cooperation and Development
OMC	— Office of Munitions Controls
OPEC	— Organization of Petroleum Exporting Countries
OTA	— Office of Technology Assessment
OTH	— Over-the-Horizon
PD 13	— Presidental Directive on Arms Transfer Policy
PLC	— Private Limited Corporation
PRC	— People's Republic of China
R&D	— Research and Development
RAAF	— Royal Australian Air Force
RACE	— Research and Development in Advanced Communications for Europe
RAN	— Royal Australian Navy
RDT&E	— Research, Development, Test, and Evaluation
ROC	— Republic of China
R.O.K.	— Republic of Korea
RPV	— Remotely Piloted Vehicle
RSI	— Rationalization, Standardization, and Interoperability
SAMC	— Singapore Aerospace Manufacturing Co.
SDI	— Strategic Defense Initiative
SDIO	— Strategic Defense Initiative Organization
SIPRI	— Stockholm International Peace Research Institute
SLEP	— Service Life Extension Program
SSE	— Singapore Shipbuilding and Engineering
STA	— Singapore Technologies Aerospace
STC	— Singapore Technology Corp.
TAAS	— Israel Military Industry
TOW	— Tube-launched Optically tracked Wire Command-Link Guided Missile
TRDI	— Technical Research and Development Institute (Japan)
U.K.	— United Kingdom
U.N.	— United Nations
U.S.	— United States
U.S.S.R.	— Union of Soviet Socialist Republics
UAV	— Unmanned Aerial Vehicle
USA	— United States Army
USAF	— United States Air Force
USN	— United States Navy
UTC	— United Technologies Corp.
WEU	— Western European Union
WW II	— World War II

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